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Interventions to increase access to or uptake of physical health screening in people with severe mental illness: a realist review

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Title of the article: Interventions to increase access to or uptake of physical health screening in people with severe mental illness: a realist review

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ABSTRACT

Objectives: To identify and evaluate interventions aimed at increasing uptake of, or access to, physical health screening by adults with severe mental illness; to examine why interventions might work.

Design: Realist Review.

Setting: Primary, secondary and tertiary care.

Results: A systematic search identified 1448 studies, of which 22 met the inclusion criteria. Studies were from Australia (n =3), Canada (n =1), Hong Kong (n =1), United Kingdom (n =11) and United States (n =6). The studies focused on breast cancer screening, infection preventive services and metabolic syndrome (MS) screening by targeting MS-related risk factors. The interventions could be divided into those focusing on 1) health service delivery changes (12 studies), using quality improvement, RCT, cluster randomized feasibility trial, retrospective audit, satisfaction survey, and cross sectional study designs, and 2) tests of tools designed to facilitate screening (10 studies) using consecutive case series, quality improvement, retrospective evaluation, and pre-post audit study designs. All studies reported improved uptake of screening, though no estimation of overall effect size was possible due to heterogeneity in study design and quality. The following factors may contribute to the success of interventions: screening 'champions' and staff feeling invested in health screening; stakeholder involvement; staff using less invasive equipment and tests; strong links with primary care and a pharmacist on the ward to advise on medication.

Conclusions: A range of interventions may be effective, but better quality research is needed to determine any effect size. Researchers should consider how interventions may work when designing and testing them in order to target better the specific needs of this population in the most appropriate setting. Behaviour change interventions to reduce identified barriers of patient and health professional resistance to screening this population are required. Resource constraints, clarity over professional roles and better coordination with primary care need to be addressed.

Strengths and limitations of this study:

- In line with the realist review methodology, a broad and inclusive study identification process was used, which was adapted iteratively to compensate for the inconsistency around how terms such as 'screening' and 'monitoring' are used.
- A realist review explores why interventions might work in a particular setting however studies provide limited evidence for this so transferability of knowledge to other settings is limited.

- A realist review is often selected to understand complex interventions, however behaviour change theory was not included in almost any intervention design, making it impossible to discern which 'active ingredients' are at work to produce the results.

INTRODUCTION

People with severe mental illness (SMI), such as schizophrenia or bipolar disorder, have been found to have a 2-3 fold increased risk of premature mortality[1]. A reduction in life expectancy of 10-20 years has been reported[2,3]. A significant cause of this disparity is attributed to preventable and treatable long-term physical health conditions, with cardiovascular disease and cancer as the first and second leading cause of death respectively in this group[2,4]. Cancer mortality in people with SMI is more likely than in the general population[5], though the incidence of disease is similar for both groups[6]. One factor which contributes to inequality in survival rates is access to cancer screening[7]. The reported 30% higher case fatality rate from cancer, may partly be due to those with SMI being more likely to present with metastases at diagnosis[5].

Other physical health conditions found to be more prevalent in people with SMI include type 2 diabetes and metabolic syndrome (MS)[8,9], tuberculosis, HIV, osteoporosis, poor dentition, impaired lung function, sexual dysfunction and obstetric complications[2]. MS is defined by the World Health Organisation[10] as glucose intolerance, diabetes mellitus and/or insulin resistance, with two or more of the following: central obesity [>0.9 in men and >0.85 in women and/or body mass index (BMI) >30 kg/m^2], raised arterial pressure [≥140/90 mmHg], microalbuminuria [≥ 20 µgm/minute or albumin/creatine ratio ≥ 30 µgm/mg] and raised plasma triglyceride [≥ 150 mg/dl and/or low HDL-C (<35 mg/dl in men and <39 mg/dl in women)].

Health screening facilitates early detection and treatment for many of these conditions, though rates of screening in people with SMI may be reduced compared to the general population. A UK survey[11] found that only 33% of people with schizophrenia had received adequate CVD screening in the previous 12 months and, internationally uptake of breast, cervical and bowel cancer screening has been found to be lower among people with SMI[6,12-15]. Effective interventions for increasing access to, or uptake of, screening for a range of conditions in the general population[16] exist. In relation to cancer screening, a Cochrane review[17] found that no intervention to promote uptake has been tested in people with SMI. This is important since qualitative work[18] indicates there are specific barriers to cancer screening uptake in people with SMI and that interventions effective in the general population may not be in the SMI population. Furthermore, barriers to screening uptake or

access may vary for different types of screening, at different stages of the screening process and between individuals[18].

Realist review methodology[19] has been devised to enable synthesis of diverse literature in order to explore not only what works for whom, as in traditional systematic reviews, but also why an intervention may work[20].

By drawing on this methodology, our objectives were to identify and evaluate interventions which may increase uptake of, or access to, any kind of physical health screening by adults with SMI, and to determine what works for whom in what setting and why. The review is described in accordance with the RAMESES reporting guidance for realist reviews[21].

METHODS

Study Selection

Inclusion and exclusion criteria

Studies of any intervention to promote access to, or uptake of, screening or monitoring for any physical health condition where participants were aged 18 years and over with a diagnosis of SMI (psychosis or bipolar disorder however diagnosed) were eligible. The UK National Screening Committee defines screening as a 'public health service in which members of a defined population (…) are asked a question or offered a test, to identify those individuals who are more likely to be helped than harmed by further tests or treatment to reduce the risk of a disease or its complications'[22]. 'Monitoring' was defined in a Cochrane[23] review as a means 'to obtain information which can then be acted on to treat or prevent a physical health problem'. We included any intervention described as promoting either screening or monitoring; for clarity the term 'screening' is used throughout. Only studies reported in English were included.

In line with the realist approach to literature synthesis[19], an inclusive approach was taken and intervention studies of any design were eligible as long as the full text was published in a peer reviewed journal. We also excluded intervention studies to improve physical health in people with SMI which may involve screening, but where uptake or access to screening was not a main outcome and service evaluations or audits which considered screening, but did not test any intervention.

Search Strategy

The protocol is published on the PROSPERO database[24]. The search strategy (Appendix 1) was informed by published, related systematic reviews[8,17,20] and was checked by a specialist health

librarian at the University of West London (Marc Forster PhD). Searching was conducted in December 2016.

Data sources

Medline, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsychINFO, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effectiveness. Reference chaining of identified studies was also conducted. No date restrictions were applied.

Search results

The initial electronic search identified 1872 potentially relevant publications; six others were identified through reference chaining. Titles and abstracts were screened independently by two team members (EB and AM). Thirty-three full texts were retrieved and screened by at least two team members (EB, AM, DT). Among the thirty-three full texts was a recent systematic review of studies of 'Strategies to implement physical health monitoring in people affected by severe mental illness'[25] which included 14 studies. Though the focus of this review was slightly different from the current, it contained one study which we had included[26]. It also included two studies which we had excluded: one[27] was not an intervention study, the other tested the validity of a health monitoring tool[28]. This led to a team discussion whereby it was decided that studies of interventions, such as health monitoring tools, were relevant to our review question. The rationale being that, although the aim of such studies was to improve the quality of screening (e.g. more health indicators measured) and ongoing monitoring, this often resulted in increased uptake. We re-screened our identified studies and those included in this review[25]. 44 studies were identified as potentially relevant and were screened by two reviewers. Twenty-two of these did not meet the inclusion criteria, a total of 22 studies were included. The screening and study selection processes are detailed in Figure 1.

Figure 1. PRISMA Flow Diagram of intervention studies included and excluded from this review

Data extraction

Each reviewer independently extracted information from up to 5 articles, with one author (EB) reviewing all studies. Data were extracted regarding study authors, geographical location and setting, year of publication, participant characteristics, features of the intervention, target of screening, outcome measures, study design and limitations.

Approach to synthesis

Similarities in intervention approach were identified and summarized across studies. Exploration of how and why different approaches might have worked was undertaken by searching for themes across studies, paying particular attention for disconfirming evidence. As there was considerable between-study variation in outcome measures meta-analysis was not possible.

RESULTS

Study characteristics

Study characteristics are detailed in Tables 1 and 2. Two studies[29,30] included breast cancer screening, one[30] considered infection preventive services and 21 studies considered metabolic syndrome screening by targeting MS-related risk factors (blood pressure (BP)[26,28-31,33-46], cholesterol/sugar[26,28,30,31-45,47] and BMI[26,28,30,31-46]. Two studies involved national screening programmes[29,30] and 20 studies developed 'in-house' screening[26,28,31-47]. Study populations included participants with schizophrenia[28-31,33-35,37-38,40,44-47], bipolar disorder[28-31,33,35,38,44-47], schizoaffective disorder[28,29,31,33,35,44-47], other psychotic disorders[28,30,34-35,38,45-46] and other mental health disorders[29-31,33,38,44-47]. Some studies did not specify the SMI[26,39,42-43] while other studies included patients on antipsychotics[32,36,41,46] with no breakdown by condition.

A range of study designs was employed (pre-post audit n=9, consecutive prospective case series design n=1, repeat audit n=1, cross-sectional study n=1, QI n=4, retrospective audit n=4, RCT n=1, cluster randomized feasibility trial n=1). Study quality of randomized trials[45-46] was assessed using the Cochrane tool[49] for assessing risk of bias. No similar 'gold standard' tool exists which could be used across the other study designs, so we assessed each study informed by the STrengthening the Reporting of OBservational studies in Epidemiology[50]. Each study was rated independently by two reviewers with discrepancies resolved by discussion. Flaws relating to the reliability of findings or the generalizability of results were highlighted in all studies (Tables 1-2); these data suggest that findings concerning the size of effect should be considered with caution.

Review outcomes

Interventions to increase *uptake* of screening are defined as interventions which support health professionals to screen for physical health conditions[28,32-48]. Interventions to increase *access* to screening are defined as interventions (targeted at health professionals or health service delivery) to increase patient/client access to screening[26,29-31].

Intervention effects

Overall, improvements in rates of screening were reported in all studies following intervention (Tables 1-2). This appeared to be independent of screening type or study design. We identified an evidence gap as only three studies[31-32,48] reported whether the results of screening were acted upon, for instance through referral or clinical intervention.

Intervention type

Studies broadly either tested a new tool to facilitate screening for health professionals[28,32-33,35-39,47] (table 1) or made complex health services delivery changes[26,29-31,40-46,48] (table 2). One intervention[26] primarily targeted service users, though in other studies[29,40,44] service user-focused interventions were included, for instance targeted education[33,40], self-management support[44] or support to attend screening[29]. Most studies included staff education[38,40,43,45-46,48] and training[28,33,35,39,42] as part of the intervention.

The data collection tools tested in Table 1 were designed to gather information required to improve MS screening[32-33,38,47] or physical health monitoring[28,34-37,39]. MS monitoring was evaluated using the following measurements: BP, smoking status, waist circumference (WC), fasting blood glucose (BG), BMI triglycerides and high density lipoprotein cholesterol. These measures were based on the following clinical guidelines: National Institute for health and Care Excellence[26,31,35-37,39,40-41], Maudsley prescribing guidelines[34,37,40-42], U.S. Preventive Services Task Force[30,44], National Heart, Lung and Blood Institute[33], American Diabetes Association[32-34,38,47], Early Psychosis Prevention and Intervention Centre[43], Psychotropic Therapeutic Guidelines[48], American Psychiatric Association Practice[28,38] and de Hert (2009) guidelines[35]. Most interventions were multi-faceted so will appear in more than one cluster. As no studies were rated of good or moderate quality it was difficult to assess whether findings of improvements in rates of screening are valid. The size of effect was not reported for any study.

Screening template: Eight studies[28,32-34,36-39] evaluated the effectiveness of using a screening tool to increase uptake and raise staff awareness of physical health screening. Barriers to successful intervention implementation included 'social desirability bias'[28,36] (patients self-report their health behaviour in an overly positive picture in an effort to please their keyworkers); low uptake of invasive test measurements e.g. WC[32,37], BP[38], fasting BG[33,37] and of data on sensitive topics[36]; difficulty to capture monitoring results onto the tool[28,32,38-39]; difficulty in obtaining equipment[37-38] and accessing laboratory services[33]; lack of integration with primary care for treatment or referral[33,37-38]; appointment non-adherence[32-33]; lack of expertise in mental health professionals to

interpret physical health results[34,37]; workload issues[32-33,38]; staff reluctant to see MS screening as their responsibility[32-33,34]. Authors across studies identified the following facilitators: investment of staff in physical health monitoring[33,36-37,39] and staff flexibility by using alternative equipment and tests[33,39].

Staff education and training: Five studies[28,33,35,38-39] included staff training as a component of the intervention. No author described the content or format of education interventions in detail. Barriers to successful intervention implementation included workload issues[33,35,38]; lack of training to spot 'social desirability bias'[28]; lack of training in mean WC measurement[28]. The following facilitators were identified: 'booster' education and team meetings[33] and investment of staff in physical health monitoring[33,39].

Computer or paper prompt for staff: Four studies[34,37,39,47] tested a computer or paper based prompts to support clinicians to monitor and screen physical health indicators. Barriers to the successful implementation of the intervention included technical constraints in terms of collecting measurement results[39,47]; low uptake of invasive test measurements e.g. WC[37] and fasting BG[37,47]; lack of expertise from mental health professionals to interpret physical health results[34,37]; unclear communication channel between primary and secondary care[34,37] and limited access to equipment and resources[34,37]. Having a clinical psychiatric pharmacist on the ward to remind clinicians to request investigations such as blood tests when appropriate and to provide the relevant guidelines and precautions when initiating hypolipidemic medication was a facilitator in two studies[37,47].

Table 2 describes twelve studies which tested interventions that delivered change in a health service setting. Most interventions were multi-faceted so appear in more than one cluster. All studies targeted adults, though in one study[42] eligible participants were 14-35 years old. Studies took place in a clozapine clinic[48], Early Intervention in Psychosis Services[41-43], Community Mental Health Team (CMHT)[31,44-45], community drop-in centre[29] and primary care[26,30]. Interventions were focused on metabolic/cardiovascular screening for all studies, except one[29] which was designed to increase rates of mammography uptake. One study[30] monitored uptake of national cancer screening services and metabolic screening. The size of effect was not reported for any study. All studies reported sub-optimal screening and monitoring at baseline, with improved levels post intervention. However, limited evidence of actions, such as referral or intervention, occurring as a result of these improvements was reported.

Staff education and training: Six studies[40,42-43,45-46,48] provided some kind of staff (working in primary and secondary care) and patient education. All studies described increased rates of monitoring following the interventions. One study[45] was rated as good quality, so generalization of results is limited. Barriers to the successful implementation of the intervention included staff time constraints[40,48]; poor communication across the primary and secondary care interface[43,45] and lack of clarity over scope of practice[48]; patient resistance to invasive tests[42,46]; staff resistance to change[40,45,46] and staff turnover[43,46]. Facilitators included team ownership and team 'champions' to encourage screening[40,42] and high visibility/structure around monitoring and better liaison with primary care[42,48].

Invitation letter to physical health screening: Three studies[26,40,42] used an invitation letter from primary care to encourage patients to attend screening as part of a physical health check-up. All studies described increased rates of monitoring following the interventions. Barriers to the successful implementation of the intervention included patient resistance to invasive tests[42] and staff resistance to change[40]. Facilitators included team[40,42] ownership and team 'champions' to encourage screening; getting stakeholders involved[40,42] and living in a suburban[26] (rather than urban) area.

Improving access to monitoring resources: Four studies[41,43,46,48] tested interventions developed to improve the collection of physical health data to increase screening. Barriers to the successful implementation of the intervention included patient resistance and lack of motivation in the screening process[41,46]; inadequate links with primary care[41,43]; no clarity about who takes responsibility for screening[41,48]; staff turnover[43,46]; staff not perceiving physical health screening as a priority[41,46]; time and resource (screening equipment) constraints[41,48]; poor recording and knowledge of screening guidelines and tests[41,48]. Facilitators included high visibility and structure around monitoring[48] and having a key worker system with key worker's duties involving screening[41].

Integrating care across health settings: Seven studies[29-31,40,42,44-45] were developed to evaluate and reduce the fragmentation of care between different care providers. New clinics to improve physical healthcare were set up and evaluated[29-31], two trials[44-45] evaluated nurse-led care management and two studies audited improvement in awareness[42] and communication[40] within the multidisciplinary care coordination team. All reported improvement in physical health monitoring or uptake of screening tests post intervention. Two studies[44-45] were rated as good quality. One study[44] reported improvement in cardiovascular disease risk among intervention subjects of an effect size

comparable to that seen in underserved populations without mental illness. Barriers to the successful implementation of the intervention included lack of coordination across the primary and secondary care interface[30,45]; patient reluctance to attend appointment/undergo screening[29,42]; staff resistance to change[40,45] and lack of a prescribing provider[44]. Facilitators included team investment in screening procedure and stakeholder involvement[29,31,40,42]; psychosocial support and trust between patients and staff to help them obtain screening[29,44] and availability of primary and specialist care[29,30,42,45].

Staff accompaniment to appointments: Three studies[29,33,40] included accompaniment of service users to appointments as part of their intervention. This type of intervention addresses potential difficulties in locating and visiting unfamiliar places which has been reported as a barrier to cancer screening uptake by some service users[18]. One study[33] from Table 1 was added to this cluster as it included staff accompaniment to screening. Barriers to the successful implementation of the intervention included staff workload issues[33,40]; difficulty to engage staff[33,40]; patient reluctance to undergo screening[29,33] and difficulty to obtain an appointment/appointment non-adherence[29,33]. Facilitators included staff feeling invested/having a sense of ownership with regard physical health screening[29,33,40]; having access to primary care/in-home phlebotomy services[29,33] and trust between clients and staff[29,33].

DISCUSSION

Statement of principal findings

A large international body of work was identified with diversity in the number of physical health conditions and clinical settings. Challenges to increase uptake of physical health screening and monitoring in people with SMI was not unique to a particular country, setting or health service configuration. The studies illustrate that people with SMI come into contact with a number of different health services. Overall there appears to be no strong evidence as to whether an intervention to increase uptake of screening would be better suited in primary or secondary care.

Identified barriers to the successful implementation of tools to facilitate screening can be clustered into resource constraints, environmental barriers, unclear boundaries around professional role and a perceived lack of professional skills and training. Authors in several studies[33,34,37,38,39,47] noted a number of logistical and resource constraints to the successful collection of measurements due to limited staff time[32,33,35,38] and difficulty accessing monitoring equipment (such as specific WC tool for obese patients and access to BP monitors in CMHTs). Staff also reported difficulties capturing

monitoring results onto the tool[28,32,38,39] (e.g. complicated guidelines to follow). Other barriers included patient resistance to exploring sensitive topics such as sexual health, and transportation, cultural and language barriers to access phlebotomy clinics and arranging an appointment.

Authors in several studies[32,33,36,37,38,47] noted low uptake of invasive test measurements e.g. WC, fasting (BG) and appointment non-adherence to cancer screening and MS monitoring. Lack of integrated care between mental health services and primary care[33,34,37,38] for treatment and referral post-diagnosis was another barrier. Some mental health staff were reluctant to see MS screening as their responsibility[32,33], leading to resistance to engage in this activity. The lack of training to collect WC data in a uniform way, and unawareness of a potential 'social desirability bias'[28,36], lead to the risk of unreliable results. Lastly, a perceived lack of expertise from mental health professionals to interpret physical health results[34,37] was raised as a potential barrier.

Several facilitators to the successful implementation of tools to facilitate screening were identified, including staff feeling invested and having a sense of 'ownership' in physical health monitoring[33,36,37,39], staff flexibility around taking measures by using alternative (e.g. less invasive) equipment and tests[33,39] and having a clinical psychiatric pharmacist[37,47] on the ward to support mental health professionals e.g. by reminding staff to request blood tests and provide the relevant guidelines and precautions to follow when hypolipidemic agents are prescribed.

Barriers to the successful implementation of health service delivery changes are clustered into resource constraints, environmental barriers, unclear boundaries around professional role and patient resistance. Authors note lack of time[33,40,47] for health professionals to allocate to screening as a barrier as well as staff turnover[43,46] and other resource constraints[41,44,47] such as lack of screening equipment and a prescribing provider. Environmental barriers include lack of coordination across the primary and secondary care interface[30,41,43,45] and difficulty for patients and staff to obtain a screening appointment[29,33]. Reluctance to engage in screening was observed from the clinician and patient perspective. In staff, limited clarity over who takes responsibility for screening[41,48] was a barrier, as well as difficulty to engage staff[33,40] in the project, staff resistance to change[40,45,46] and staff not perceiving physical health screening as a priority[41,46]. In patients, reluctance to engage with screening was identified as lack of motivation/skepticism in the screening process[41,46], appointment non-adherence[29,33,42] and particular resistance to invasive tests[42,46].

Facilitators to the successful implementation of health service delivery changes include having team 'champions' or a key worker to encourage screening, having staff that feel invested/a sense of ownership with regard physical health screening[29,33,40,41,42], stakeholder involvement[29,31,40, 42], having strong links to primary care and specialist services[29,30,33,42,45,48] including at-home phlebotomy services and established trust between clients and staff[29,33,44]. Barriers to the successful implementation of tools and health service delivery changes to facilitate screening include workload issues, resource constraints such as difficulty accessing monitoring equipment, patient resistance to screening and difficulty in arranging an appointment, fragmented links between primary and secondary care, unclear professional role boundaries for screening and staff resistance to engage in screening. Facilitators to the successful implementation of tools and health service delivery changes to facilitate screening include staff feeling invested and a sense of 'ownership' to engage in physical health monitoring.

The quality of data identified was generally low, it is therefore not possible to determine the size of effect any intervention may have. Several potentially useful intervention approaches were identified however. A key aim of this review was to identify what approach worked for whom. However, this was not achieved since few studies tested this. Nevertheless, the review identified specific barriers and facilitators to screening uptake or access in people with SMI which should be considered in future studies.

Future studies should be reported using the TiDieR guidelines[49] and Medical Research Council (MRC)[50] guidance to make explicit how the components of complex interventions may work. Similarly, use of behaviour change theory was not considered in intervention design – some studies acknowledged it was not considered – which provides no insight into what might have impacted on staff and service user behaviour to increase uptake. Few interventions were designed in collaboration with service users, nor were their preferences explored.

There are no longitudinal studies therefore this review is unable to clarify if screening is maintained post intervention and whether the increase in uptake is sustainable or a consequence of the Hawthorne effect whereby health professional behavior reacts to being observed. An evidence gap was identified as only three studies[31-32,46] reported on whether the results of screening were acted upon, for instance through referral or clinical intervention. One study[33] aims to make annual MS screening a 'routine responsibility' for the mental health team but acknowledges it cannot refer patients to primary care.

Study limitations

There is inconsistency around how terms such as 'screening' and 'monitoring' are used which hampers comparative exercises. Our method of deploying them may differ to that of others who may use different terms and include different studies. To compensate for this, and in line with realist review methodology, we used a broad and inclusive study identification process which we adapted iteratively through the study selection process, as described above. We identified a wide range of studies with varied participants, settings, interventions and intervention targets; a narrower review may provide answers which are more applicable to particular situations, however, the lack of good quality evidence identified suggests that this is unlikely to be the case.

CONCLUSION

Policy implications

Interventions to reduce patient and health professional resistance to screening which are informed by behaviour change theory should be developed and tested. Strategies to improve coordination between primary and secondary care are also needed, as are guidelines to clarify professional role boundaries. Resource constraints such as staff time and lack of monitoring equipment in mental health settings need to be addressed in the various clinics where screening occurs. Involving service users in intervention design is also important so that their preferences for location, frequency and type of support can be identified and targeted. Consideration of how interventions are likely to work should be made during development and testing.

A. Contributors: EB, CB, SC and DT were involved in the study design. EB, MGH, FLG, AM and DT acquired and analysed the data. EB, SC, FLG and PW interpreted the data. FLG and AM drafted the manuscript. CB, SC, FLG and PW critically revised the manuscript for intellectual content. EB, CB, SC, MGH, CG, FLG, AM, DT and PW contributed to writing and interpretation of the results.

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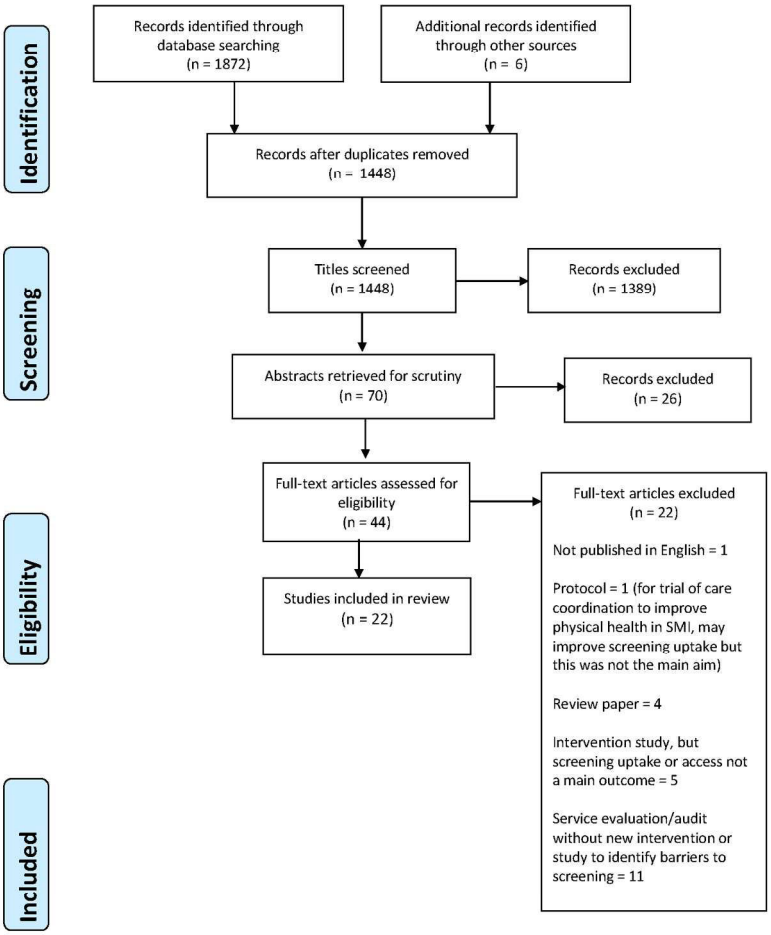

Figure 1. PRISMA Flow Diagram of intervention studies included and excluded from this review

210x297mm (199 x 200 DPI)

Appendix

1. Search terms used in search strategy

The following terms will be used in all data sources: (cardiovascular OR vascular OR CVD OR 'chronic heart disease' OR 'coronary heart disease' OR CHD OR diabetes OR metabolic OR aneurysm) OR cancer OR neoplasm OR carcinoma OR maligna* OR *tumour OR tumor OR breast OR mammogra* OR bowel OR cervical OR pap*) OR (dental OR dentist OR tooth OR teeth) OR (eye OR retinopathy) AND ('mass screening' OR surveillance*) OR "Screening Test" OR ((cholesterol OR fecal OR faecal OR blood OR HIV OR sig¬moid OR tuberculosis) AND test*) OR "health check*" AND (letter OR mail* OR phone OR telephone OR 'reminder system*' OR 'videotape recording*' OR 'audiotape recording*' OR questionnaire* OR strateg* OR alert* OR hotline OR community OR media) AND (intervention* OR goal OR 'behav* change' OR 'implementation intention*' OR plans OR planned OR planning OR plan OR educat* OR campaign* OR barriers OR intention* OR 'behav* outcome' OR outcome OR 'lifestyle change' OR longitudinal OR 'follow up' OR motivation*) AND (satisf* OR dropout* OR 'drop out' OR attrition OR uptak* OR adher* OR compliance OR complie* OR comply* OR 'patient acceptance of health care' OR encourag* OR improve* OR improving OR increas* OR promot* OR particip* OR nonattend* OR 'non attend' OR accept* OR attend* OR attitud* OR utilisation OR utilization OR refus* OR respond* OR respons* OR reluctan* OR nonrespon* OR 'non respon*' OR incidence OR prevalence OR prevalence OR satisfaction OR cooperat* OR 'co operat*') AND ('severe mental illness' OR 'mental illness' OR schizophrenia OR catatonic OR paranoid OR disorganized OR disorganised OR bipolar OR manic OR psychosis OR psychotic OR psychiatric OR schizophrenic OR SMI)

Table 1: Tools to facilitate screening

Study	Year	Country	Population Studied	Intervention	Method(s) applied	Results	Main study weaknesses
Bressington et al[28]	2014	Hong Kong	148 community based psychiatric service users	Training for community psychiatric nurses on how to use the HIP and how to conduct the required physical examinations	Consecutive prospective case series design Pre-post evaluation of structured questionnaire as a screening tool for physical health problems	Significant improvement in self-reported levels of exercise and reduced prescriptions for mean waist circumference increased at follow-up but may be due to measurement error (87.32 to 89.90) Lack of deterioration in most areas of cardiovascular risk (BMI mean: 25.79 to 25.66, weight mean: 66.76 to 66.49) Reduction in medicines prescribed for physical health problems: diabetes medication (p = 0.04) and prescriptions for hypertension reduced at follow-up from 21% to 14% of patients General improvements in health behaviours over the 12 month period: 7% increase in number of patients eating sufficient fruit and	No randomization, no control group Selection bias

						vegetables, but only exercise improved to a statistically significant level (p = 0.02)	
Castillo et al[33]	2015	USA	141 community based assertive outreach service users	Systematic screening protocol for MS and educational sessions for staff and service users	Quality Improvement	75 (53%) participants met criteria for MS Five of these diagnoses came from use of adapted diagnostic criteria using random glucose measurements Of the 66 participants who did not have MS, only 9 had no metabolic risk factors 34 met 2 criteria and the remaining 23 met 1 criterion for MS	No randomization, no control group
Delmonte et al[47]	2012	USA	Service users on a general psychiatric inpatient unit – 171 at pre alert and 157 post alert	Use of computerized electronic patient alerts to enhance metabolic monitoring (fasting blood glucose, lipid)	Retrospective chart review of notes and tests ordered to assess for MS Pre-post study design	Significant difference in availability of metabolic monitoring data post intervention: 12.9% to 47.8% in number of service users with both fasting glucose level & fasting lipid panel	No randomization, no control group Open to time bias
Gonzalez et al[34]	2010	UK	Male and female community based service users taking regular antipsychotic medication Inner city London population	Local adaptation of clinical guidelines Implementation of monitoring tool: A4 page filed in the patients' records, both as a prompt to doctors	Retrospective audit of patients' clinical records for physical health monitoring Systematic randomization by	Post intervention: significant improvement in all tests (glucose: 24.6% to 72.6%, lipids: 7.1% to 52.8%, liver function: 38.9% to 79.2%) except HbA1c	No randomization, no control group Did not include other measure for detection of MS and did not include ECG Limited time between

			First audit N=126 Second audit N=106 No significant difference in demographic details of both samples	regarding their patients' need for the physical monitoring and as an instrument to facilitate later data collection	selecting every 4th file in alphabetical order until 25% of caseload was selected	(3.2 to 5.7%) and Prolactin (0.8% to 0) Implementation of the monitoring tool achieved in 48% of re-audit sample	audits to allow embedding of the intervention Other factors may have resulted in improvements seen due to increased awareness within the service due to local policy and national guidelines or other potential factors
Hardy et al[35]	2014	UK	400 community based service users with SMI	Two-hour training for practice nurses to increase level of screening for cardiovascular disease (CVD) risk factors with lifestyle counselling (health check includes seven elements)	Repeat audit to monitor how well primary care practitioners are screening people with SMI for CVD following training	Training practice nurses on CVD prevention increased number of service users receiving wide ranging health check Pre-training: *n* = 33, 8% Post-training: *n* = 60, 15%, *p* = .01 Increase in number of service users receiving lifestyle interventions	No randomization, no control group Unclear why other 26 primary care centres did not participate Did not look at any other factor (e.g. other training, professional development, targets by the organisation) which could have influenced staff Possible Hawthorne effect and no exploration of whether increased screening improves patient outcomes
Kioko et al[32]	2016	USA	100 notes of community mental health service users	Recommended MS monitoring and screening tool to improve identification of patients at risk of MS	Pre-post intervention design to evaluate the effectiveness of using a recommended MS monitoring and screening tool to improve identification of MS risk for service	Percentage of laboratory tests ordered were 62% post-intervention compared to 22% pre-intervention	No randomization, no control group Difficulty obtaining waist circumference - parameter frequently omitted Lack of agreement over who is responsible for ordering labs and following

					users		up results Small sample size - difficult to generalize results
Shuel et al[36]	2010	UK	31 community based psychiatric service users 9 Mental Health Nurses 4 Psychiatrists 12 GPs	Paper sheet screening instrument (HIP)	Retrospective audit of patient and clinician views using semi-structured interviews	Thirty-one patients participated in Audit Mean number of parameters per patient requiring intervention was 6.1 and a total of 189 physical health issues were identified At least one physical health issue was identified per patient High prevalence of obesity, poor diet (41% of patients) and lack of exercise 14 referrals for potentially serious conditions including raised glucose and lipids, hypertension and cardiac problems	No randomization, no control group One-year FU assessment planned to assess changes in modifiable factors identified by the HIP
Vasudev et al[37]	2012	UK	23 male inpatients on a medium secure forensic psychiatric rehab unit diagnosed with SMI and on antipsychotics	Introduction of a physical health monitoring sheet by the Trust to prompt staff to do the checks	Pre-post audit of physical health monitoring (twelve months apart)	At re-audit 100% of service users had up to date records on the physical health monitoring sheet At follow-up increased number of service users prescribed hypolipidaemic agents	No randomization, no control group Small male-only sample Type of ward and environment could influence patient engagement and motivation

						Significant reduction in CVD risk at follow up	
Wiechers et al[38]	2012	USA	206 adult service users of a psychiatric resident outpatient clinic	Metabolic Screening Bundle template Three one-hour education sessions conducted to review antipsychotic medication-associated metabolic abnormalities	Audits of the EMR completed at baseline and each quarter for the following year Quality Improvement	Rates component parts of the Metabolic Screening Bundle in the preceding 12 months increased from baseline audit through the Quarter 4 audit: BMI 5% to 44%; BP 4% to 39%; Fasting glucose 15% to 55%; Fasting lipid panel 14% to 55%	No randomization, no control group Chart audit unable to capture undocumented results/results documented other than psychiatry notes that may have been reviewed by the resident but not remarked on in the progress-note Unclear whether gains made with intervention and cohort of residents can be sustained without a dedicated group of residents championing change
Yeomans et al[39]	2014	UK	335 service users on the primary care SMI register	GP practices received 30-minute staff training on how to use a computerized physical screening template designed for annual health checks	Retrospective evaluation of computerized template designed for annual physical health check	23% service users with a computerized template review had data rich QRisk2 compared QRisk2 scores above 20% seen in 3.9% of template based reviews Use of template increased detection risk for CVD	No randomization, no control group Method dependent on accurate record keeping and clinician behaviour No record of unrecorded activity taking place which would contribute to annual patient review GPs selected patients for review: possible bias acknowledged but considered unlikely Quality and Outcomes

							Framework incentive for annual health checks removed and replaced by CQUIN.

Table 2: Studies of health service delivery changes

First Author	Year	Country	Population Studied	Intervention	Method(s) applied	Results	Main study weaknesses
Abdallah et al[40]	2016	UK	95 service users with schizophrenia living in care homes	Patient education and education of care home staff	Quality Improvement	Improvement in culture within care home where staff and service users actively participated in physical health monitoring Blood pressure and weight measured in 68% of patients compared to 10% and 0 at baseline 55% of patients had pulse measured compared to 0 at baseline 68% had bloods done compared to 0 at baseline	No randomization, no control group Small sample, difficult to determine results as in later PDSA cycles the interventions did not target only the patient group included in the results
Druss et al[44]	2010	USA	407 service users with SMI under care of community teams	Participants with SMI at an urban community mental health centre were randomly assigned to either the medical care management	Randomized Control Trial	12-month follow-up evaluation: intervention group received average 58.7% of recommended preventive	Low risk of bias (Performance bias as control group - treatment as usual - not blinded) Broad entry criteria

				intervention or usual care For individuals in the intervention group, care managers provided communication and advocacy with medical providers, health education, and support in overcoming system-level fragmentation and barriers to primary medical care		services compared with 21.8% in usual care Significantly higher proportion of evidence-based services for cardio-metabolic conditions (34.9% versus 27.7%) Higher likelihood to have primary care provider (71.2% versus 51.9%) Intervention group showed significant improvement on SF-36 mental component summary (8.0% [versus a 1.1% decline in the usual care group]) Scores on Framingham Cardiovascular Risk Index significantly better in intervention	limited the statistical power to examine outcomes for individual medical conditions Study was conducted in a single site so replication would be needed to fully assess generalizability to different types of community mental health settings

						group (6.9%) than usual care group (9.8%)	
Hardy & Gray[26]	2012	UK	92 community service users with severe and enduring mental illness 338 service users with diabetes	Retrospective comparison of response rate of patients with SMI and diabetes to an invitation appointment letter to attend a primary care health check Patients with SMI sent an appointment at a predetermined time and date. Annual health check for patients with SMI followed the HIP guidance	Retrospective audit	66% service users with SMI attended appointment 81% service users with diabetes attended appointment Service users with diabetes 2.2 more likely to attend health check	No randomization, no control group Unclear if sample reflects whole population of SMI (or diabetes)
Heyding et al[29]	2005	Canada	Disadvantaged women aged 50-70 who attended inner-city drop-in centre (N = 158 in 1995-2001 and N = 89 in 2002)	Drop-in centre and nearby hospital in Toronto initiated collaborative breast cancer screening project in which staff of drop-in centre accompanied small groups of women for mammography visits at weekly pre-arranged time	Pre-post audit Comparison between screening before and after intervention year	Increase from average of 4.7% women receiving a mammography to 29.2%	No randomization, no control group Observational rather than experimental design Limited control over extraneous variables Audited

							documentation may have been inaccurate or incomplete
Latoo et al[41]	2015	UK	52-55 service users receiving antipsychotics in Early intervention in Psychosis service	Advancing Quality Alliance design to examine six physical health parameters: weight, height, BMI, BP, blood glucose and serum lipids	Retrospective review of clinical records following improvement in physical health monitoring	Screening and monitoring of six parameters: At 4 weeks 29 patients recorded screening, 19 (66%) of which had six types of screening At 24 months, out of 16 patients who had their screening recorded, 15 (95%) had 6 types of screening	No control group No randomized design to test new screening and assessment method
Millar[31]	2010	UK	152 community based service users 100 inpatient and community service users all prescribed antipsychotic medication	Dundee Health Screening Clinic developed to address needs of this population by monitoring physical health and providing follow-up to ensure that patients received necessary care	Mixed Methods: pilot study, audit and satisfaction survey	Heavy burden of physical health problems identified in Phase One (66% obesity, 60% elevated cholesterol, 32% hypertension) Of the first 100 patients audited: 33% had MS	No randomization, no control group Generalizability may be limited due to differences in availability of resources in different areas, though no additional resources were

						99% agreed health screening important 65% reported lifestyle change	used to develop the intervention
Osborn et al[45]	2010	UK	121 service users under the care of a community mental health team	Nurse-led screening programme and education pack regarding appropriate screening for cardiovascular disease (CVD) related risk factors	Cluster Randomized Feasibility trial	After the trial CVD screening increased in both arms but participants from intervention arm were significantly more likely to have received screening for blood pressure (96% vs 68%), cholesterol (66.7% vs 26.9%), glucose (66.7% vs 36.5%), BMI (92.5% vs 65.2%), smoking status (88.2% vs 57.8%) and have 10 year CVD risk score calculated (38.2% vs 10.9%).	Low risk of bias Response rate in the recruitment for outcome data was main limitation Recruitment was time limited because of funding Participants who provided outcome data may have been a biased sample of CMHT patients therefore generalization of results is difficult
Rosenbaum et al[46]	2014	Australia	60 service users on inpatient psychiatric ward	Educational training including waist circumference (WC) measurement Change in	Pre-post audit of the frequency of WC Documentation before/after	Improved measurement by nurses of WC from 0-58% WC was higher in	No randomization, no control group Not all staff were able to receive

			25 mental health nurses	assessment-form design	intervention	these patients than general population 19% had BMI within a healthy range, 37% smoked, 31% were hypertensive	intervention
Thompson et al[43]	2011	Australia	118 files of service users under the care of Early Psychosis and Prevention Centre service	Educational intervention for staff Development of local guidelines, provision of monitoring equipment, prompts in patients' records and regular reviews	Pre-post audit of completion of metabolic screens	Improvements in screening and monitoring of four metabolic indices at the post-intervention time point Individual rates were higher for screening (74.4% to 84.9%) than monitoring outcomes (24.4% to 41.6%) Rates ranged between 17.4% for blood lipids to 34.9% for obesity measures	No randomization, no control group Naturalistic setting
Vasudev & Martindale[42]	2010	UK	66-72 service users aged 14 to 35 under care of Early Intervention	In-house training for members of the Early Intervention Service Interventions	Pre-post audit	Number of patients having at least one annual physical health check increased	No randomization, no control group Focuses on Early Intervention so

			service	between audit – in-house training, physical health mandatory component on care plan review, joint responsibility for communicating with GP, referral information updated to include physical health, liaison with wider MDT		from 20% to 58% Patients who had undergone physical health check at re-audit, a record of some/all of the checks was available in the notes for 75% of patients	many people do not have a formal diagnosis of SMI e.g. schizophrenia Only 7 months between audits, therefore very short time to measure long term impact
Wilson et al[48]	2014	Australia	107 to 232 service users attending clozapine clinic	Six education sessions covering test interpretation, MS, diabetes management, obesity, smoking cessation and lifestyle interventions "Let's Get Physical" initiative – designation of two months annually as physical health months (PHM) during which time revised service protocol required metabolic monitoring for all	Quality Improvement Mixed Methods	Completion rates of metabolic monitoring: 69.2% at first month and 65.1% at second month Limited evidence of actions post results	No randomization, no control group Limited possibility of generalization due to single site and very specific population

				eligible patients Service protocols were revised to require metabolic monitoring of all eligible patients during PHMs			
Xiong et al[14]	2015	USA	Four mental health clinics providing outpatient care	Comparison of preventive services used in an integrated behavioural health primary care clinic with two existing community mental health programmes	Cross-sectional study comparing use of preventative services 350 surveys	Patients on antipsychotic medication were less likely to use preventive non-cancer services than their comparison group (p = 0.04) Integrated Behavioral Health Primary Care unit associated with higher overall service utilization than a community mental health team ($p < 0.001$)	No randomization, no control group Unable to adjust for confounding factors such as severity of illness

PRISMA 2009 Checklist

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

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Figure 1 PRISMA Diagram
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Tables 1 and 2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Tables 1 and 2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	N/A
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Tables 1 and 2
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	10-12
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12-13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	13

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097.

PRISMA 2009 Checklist

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Interventions to increase access to or uptake of physical health screening in people with severe mental illness: a realist review

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Title of the article: Interventions to increase access to or uptake of physical health screening in people with severe mental illness: a realist review

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ABSTRACT

Objectives: To identify and evaluate interventions aimed at increasing uptake of, or access to, physical health screening by adults with severe mental illness; to examine why interventions might work.

Design: Realist Review.

Setting: Primary, secondary and tertiary care.

Results: A systematic search identified 1448 studies, of which 22 met the inclusion criteria. Studies were from Australia (n =3), Canada (n =1), Hong Kong (n =1), United Kingdom (n =11) and United States (n =6). The studies focused on breast cancer screening, infection preventive services and metabolic syndrome (MS) screening by targeting MS-related risk factors. The interventions could be divided into those focusing on 1) health service delivery changes (12 studies), using quality improvement, RCT, cluster randomized feasibility trial, retrospective audit, cross-sectional study and satisfaction survey designs, and 2) tests of tools designed to facilitate screening (10 studies) using consecutive case series, quality improvement, retrospective evaluation, and pre-post audit study designs. All studies reported improved uptake of screening, or that patients had received screening they would not have had without the intervention. No estimation of overall effect size was possible due to heterogeneity in study design and quality. The following factors may contribute to intervention success: staff and stakeholder involvement in screening; staff using less invasive equipment; strong links with primary care and having a pharmacist on the ward.

Conclusions: A range of interventions may be effective, but better quality research is needed to determine any effect size. Researchers should consider how interventions may work when designing and testing them in order to target better the specific needs of this population in the most appropriate setting. Behaviour change interventions to reduce identified barriers of patient and health professional resistance to screening this population are required. Resource constraints, clarity over professional roles and better coordination with primary care need to be addressed.

Strengths and limitations of this study:

- In line with the realist review methodology, a broad and inclusive study identification process was used, which was adapted iteratively to compensate for the inconsistency around how terms such as ‘screening’ and ‘monitoring’ are used.
- A realist review explores why interventions might work in a particular setting however studies provide limited evidence for this so transferability of knowledge to other settings is limited.

- A realist review is often selected to understand complex interventions, however behaviour change theory was not included in almost any intervention design, making it impossible to discern which 'active ingredients' are at work to produce the results.

INTRODUCTION

People with severe mental illness (SMI), such as schizophrenia or bipolar disorder, have been found to have a 2-3 fold increased risk of premature mortality[1]. A reduction in life expectancy of 10-20 years has been reported[2,3]. A significant cause of this disparity is attributed to preventable and treatable long-term physical health conditions, with cardiovascular disease and cancer as the first and second leading cause of death respectively in this group[2,4]. Cancer mortality in people with SMI is more likely than in the general population[5], though the incidence of disease is similar for both groups[6]. One factor which contributes to inequality in survival rates is access to cancer screening[7]. The reported 30% higher case fatality rate from cancer, may partly be due to those with SMI being more likely to present with metastases at diagnosis[5].

Other physical health conditions found to be more prevalent in people with SMI include type 2 diabetes and metabolic syndrome (MS)[8,9], tuberculosis, HIV, osteoporosis, poor dentition, impaired lung function, sexual dysfunction and obstetric complications[2]. MS is defined by the World Health Organisation[10] as glucose intolerance, diabetes mellitus and/or insulin resistance, with two or more of the following: central obesity [>0.9 in men and >0.85 in women and/or body mass index (BMI) >30 kg/m^2], raised arterial pressure [≥140/90 mmHg], microalbuminuria [≥ 20 µgm/minute or albumin/creatine ratio ≥ 30 µgm/mg] and raised plasma triglyceride [≥ 150 mg/dl and/or low HDL-C (<35 mg/dl in men and <39 mg/dl in women)].

Health screening facilitates early detection and treatment for many of these conditions, though rates of screening in people with SMI may be reduced compared to the general population. A UK survey[11] found that only 33% of people with schizophrenia had received adequate CVD screening in the previous 12 months and, internationally uptake of breast, cervical and bowel cancer screening has been found to be lower among people with SMI[6,12-15]. Effective interventions for increasing access to, or uptake of, screening for a range of conditions in the general population[16] exist. In relation to cancer screening, a Cochrane review[17] found that no intervention to promote uptake has been tested in people with SMI. This is important since qualitative work[18] indicates there are specific barriers to cancer screening uptake in people with SMI and that interventions effective in the general population may not be in the SMI population. Furthermore, barriers to screening uptake or

access may vary for different types of screening, at different stages of the screening process and between individuals[18].

Realist review methodology[19] has been devised to enable synthesis of diverse literature in order to explore not only what works for whom, as in traditional systematic reviews, but also why an intervention may work[20].

By drawing on this methodology, our objectives were to identify and evaluate interventions which may increase uptake of, or access to, any kind of physical health screening by adults with SMI, and to determine what works for whom in what setting and why. The review is described in accordance with the RAMESES reporting guidance for realist reviews[21].

METHODS

Study Selection

Inclusion and exclusion criteria

Studies of any intervention to promote access to, or uptake of, screening or monitoring for any physical health condition where participants were aged 18 years and over with a diagnosis of SMI (psychosis or bipolar disorder however diagnosed) were eligible. Uptake of screening was the main outcome of interest. Patient related outcomes were not an inclusion criteria, but were included in the Supplementary Tables following the review of the studies, to provide important additional information and give a rounded picture of the effectiveness of the interventions. The UK National Screening Committee defines screening as a 'public health service in which members of a defined population (…) are asked a question or offered a test, to identify those individuals who are more likely to be helped than harmed by further tests or treatment to reduce the risk of a disease or its complications'[22]. 'Monitoring' was defined in a Cochrane[23] review as a means 'to obtain information which can then be acted on to treat or prevent a physical health problem'. We included any intervention described as promoting either screening or monitoring; for clarity the term 'screening' is used throughout. Only studies reported in English were included.

In line with the realist approach to literature synthesis[19], an inclusive approach was taken and intervention studies of any design were eligible as long as the full text was published in a peer reviewed journal. We also excluded intervention studies to improve physical health in people with SMI which may involve screening, but where uptake or access to screening was not a main outcome and service evaluations or audits which considered screening, but did not test any intervention.

Search Strategy

The protocol is published on the PROSPERO database[24]. The search strategy (Appendix 1) was informed by published, related systematic reviews[8,17,20] and was checked by a specialist health librarian at the University of West London (Marc Forster PhD). Searching was conducted in December 2016.

Data sources

Medline, Embase, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PsychINFO, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effectiveness. Reference chaining of identified studies was also conducted. No date restrictions were applied.

Search results

The initial electronic search identified 1872 potentially relevant publications; six others were identified through reference chaining. Titles and abstracts were screened independently by two team members (EB and AM). Thirty-three full texts were retrieved and screened by at least two team members (EB, AM, DT). Among the thirty-three full texts was a recent systematic review of studies of 'Strategies to implement physical health monitoring in people affected by severe mental illness'[25] which included 14 studies. Though the focus of this review was slightly different from the current, it contained one study which we had included[26]. It also included two studies which we had excluded: one[27] was not an intervention study, the other tested the validity of a health monitoring tool[28]. This led to a team discussion whereby it was decided that studies of interventions, such as health monitoring tools, were relevant to our review question. The rationale being that, although the aim of such studies was to improve the quality of screening (e.g. more health indicators measured) and ongoing monitoring, this often resulted in increased uptake. We re-screened our identified studies and those included in this review[25]. 44 studies were identified as potentially relevant and were screened by two reviewers. Twenty-two of these did not meet the inclusion criteria, a total of 22 studies were included. The screening and study selection processes are detailed in Figure 1.

Figure 1. PRISMA Flow Diagram of intervention studies included and excluded from this review

Data extraction

Each reviewer independently extracted information from up to 5 articles, with one author (EB) reviewing all studies. Data were extracted regarding study authors, geographical location and

setting, year of publication, participant characteristics, features of the intervention, target of screening, outcome measures, study design and limitations.

Approach to synthesis

Similarities in intervention approach were identified and summarized across studies. Exploration of how and why different approaches might have worked was undertaken by searching for themes across studies, paying particular attention for disconfirming evidence. As there was considerable between-study variation in outcome measures meta-analysis was not possible.

RESULTS

Study characteristics

Study characteristics are detailed in Supplementary Tables 1 and 2. Two studies[29,30] included breast cancer screening, one[30] considered infection preventive services and 21 studies considered metabolic syndrome screening by targeting MS-related risk factors (cholesterol/sugar[26,28,31-48], blood pressure (BP)[26,28-31,33-46] and BMI[26,28,30,31-46,48]). Two studies involved national screening programmes[29,30] and 20 studies developed 'in-house' screening[26,28,31-48]. Study populations included participants with schizophrenia[28-31,33-35,37-38,40,44-47], bipolar disorder[28-31,33,35,38,44-47], schizoaffective disorder[28,29,31,33,35,44-47], other psychotic disorders[28,30,34-35,38,45-46] and other mental health disorders[29-31,33,38,44-46]. Some studies did not specify the SMI[26,39,42-43] while other studies included SMI patients on antipsychotics[32,36,41,47,48] with no breakdown by condition. Some of the participants in a few of the included studies had mental health disorders other than SMI. In those studies, there was a minimum of 45% of participants who had either a psychosis or bipolar disorder diagnosis.

A range of study designs was employed (pre-post audit n=9, consecutive prospective case series design n=1, repeat audit n=1, cross-sectional study n=1, QI n=4, retrospective audit n=4, RCT n=1, cluster randomized feasibility trial n=1). Study quality of randomized trials[45-46] was assessed using the Cochrane tool[49] for assessing risk of bias. No similar 'gold standard' tool exists which could be used across the other study designs, so we assessed each study informed by a simple checklist based on the STrengthening the Reporting of OBservational studies in Epidemiology[50] (STROBE) statement and a recent review of tools to assess bias in observational studies[51]. Each study was rated independently by two reviewers with discrepancies resolved by discussion. Flaws relating to the reliability of findings or the generalizability of results were highlighted in all studies (Supplementary

Tables 1-2); these data suggest that findings concerning the size of effect should be considered with caution.

Review outcomes

Interventions to increase *uptake* of screening are defined as interventions which support health professionals to screen for physical health conditions[28,32-48]. Interventions to increase *access* to screening are defined as interventions (targeted at health professionals or health service delivery) to increase patient/client access to screening[26,29-31].

Intervention effects

Overall, improvements in rates of screening were reported in all studies following intervention (Supplementary Tables 1-2). This appeared to be independent of screening type or study design. We identified an evidence gap as only three studies[31-32,48] reported whether the results of screening were acted upon, for instance through referral or clinical intervention.

Intervention type

Studies broadly either tested a new tool to facilitate screening for health professionals[28,32-33,35-39,47] (Supplementary Table 1) or made complex health services delivery changes[26,29-31,40-46,48] (Supplementary Table 2). One intervention[26] primarily targeted service users, though in other studies[29,40,44] service user-focused interventions were included, for instance targeted education[33,40], self-management support[44] or support to attend screening[29]. Most studies included staff education[38,40,43,45-46,48] and training[28,33,35,39,42] as part of the intervention.

The data collection tools tested in Supplementary Table 1 were designed to gather information required to improve MS screening[32-33,38,47] or physical health monitoring[28,34-37,39]. MS monitoring was evaluated using the following measurements: BP, smoking status, waist circumference (WC), fasting blood glucose (BG), BMI triglycerides and high density lipoprotein cholesterol. These measures were based on the following clinical guidelines: National Institute for health and Care Excellence[26,31,35-37,39,40-41], Maudsley prescribing guidelines[34,37,40-42], U.S. Preventive Services Task Force[30,44], National Heart, Lung and Blood Institute[33], American Diabetes Association[32-34,38,47], Early Psychosis Prevention and Intervention Centre[43], Psychotropic Therapeutic Guidelines[48], American Psychiatric Association Practice[28,38] and de Hert (2009) guidelines[35]. Most interventions were multi-faceted so will appear in more than one cluster. As no studies were rated of good or moderate quality it was difficult to assess whether findings of improvements in rates of screening are valid. The size of effect was not reported for any study.

Screening template: Eight studies[28,32-34,36-39] evaluated the effectiveness of using a screening tool to increase uptake and raise staff awareness of physical health screening. Barriers to successful intervention implementation included 'social desirability bias'[28,36] (patients self-report their health behaviour in an overly positive picture in an effort to please their keyworkers); low uptake of invasive test measurements e.g. WC[32,37], BP[38], fasting BG[33,37] and of data on sensitive topics[36]; difficulty to capture monitoring results onto the tool[28,32,38-39]; difficulty in obtaining equipment[37-38] and accessing laboratory services[33]; lack of integration with primary care for treatment or referral[33,37-38]; appointment non-adherence[32-33]; lack of expertise in mental health professionals to interpret physical health results[34,37]; workload issues[32-33,38]; staff reluctant to see MS screening as their responsibility[32-33,34]. Authors across studies identified the following facilitators: investment of staff in physical health monitoring[33,36-37,39] and staff flexibility by using alternative equipment and tests[33,39].

Staff education and training: Five studies[28,33,35,38-39] included staff training as a component of the intervention. No author described the content or format of education interventions in detail. Barriers to successful intervention implementation included workload issues[33,35,38]; lack of training to spot 'social desirability bias'[28]; lack of training in mean WC measurement[28]. The following facilitators were identified: 'booster' education and team meetings[33] and investment of staff in physical health monitoring[33,39].

Computer or paper prompt for staff: Four studies[34,37,39,47] tested a computer or paper based prompts to support clinicians to monitor and screen physical health indicators. Barriers to the successful implementation of the intervention included technical constraints in terms of collecting measurement results[39,47]; low uptake of invasive test measurements e.g. WC[37] and fasting BG[37,47]; lack of expertise from mental health professionals to interpret physical health results[34,37]; unclear communication channel between primary and secondary care[34,37] and limited access to equipment and resources[34,37]. Having a clinical psychiatric pharmacist on the ward to remind clinicians to request investigations such as blood tests when appropriate and to provide the relevant guidelines and precautions when initiating hypolipidemic medication was a facilitator in two studies[37,47].

Supplementary Table 2 describes twelve studies which tested interventions that delivered change in a health service setting. Most interventions were multi-faceted so appear in more than one cluster. All studies targeted adults, though in one study[42] eligible participants were 14-35 years old. Studies

took place in a clozapine clinic[48], Early Intervention in Psychosis Services[41-43], Community Mental Health Team (CMHT)[31,44-45], community drop-in centre[29] and primary care[26,30]. Interventions were focused on metabolic/cardiovascular screening for all studies, except one[29] which was designed to increase rates of mammography uptake. One study[30] monitored uptake of national cancer screening services and metabolic screening. The size of effect was not reported for any study. All studies reported sub-optimal screening and monitoring at baseline, with improved levels post intervention. However, limited evidence of actions, such as referral or intervention, occurring as a result of these improvements was reported.

Staff education and training: Six studies[40,42-43,45-46,48] provided some kind of staff (working in primary and secondary care) and patient education. All studies described increased rates of monitoring following the interventions. One study[45] was rated as good quality, so generalization of results is limited. Barriers to the successful implementation of the intervention included staff time constraints[40,48]; poor communication across the primary and secondary care interface[43,45] and lack of clarity over scope of practice[48]; patient resistance to invasive tests[42,46]; staff resistance to change[40,45,46] and staff turnover[43,46]. Facilitators included team ownership and team 'champions' to encourage screening[40,42] and high visibility/structure around monitoring and better liaison with primary care[42,48].

Invitation letter to physical health screening: Three studies[26,40,42] used an invitation letter from primary care to encourage patients to attend screening as part of a physical health check-up. All studies described increased rates of monitoring following the interventions. Barriers to the successful implementation of the intervention included patient resistance to invasive tests[42] and staff resistance to change[40]. Facilitators included team[40,42] ownership and team 'champions' to encourage screening; getting stakeholders involved[40,42] and living in a suburban[26] (rather than urban) area.

Improving access to monitoring resources: Four studies[41,43,46,48] tested interventions developed to improve the collection of physical health data to increase screening. Barriers to the successful implementation of the intervention included patient resistance and lack of motivation in the screening process[41,46]; inadequate links with primary care[41,43]; no clarity about who takes responsibility for screening[41,48]; staff turnover[43,46]; staff not perceiving physical health screening as a priority[41,46]; time and resource (screening equipment) constraints[41,48]; poor recording and

knowledge of screening guidelines and tests[41,48]. Facilitators included high visibility and structure around monitoring[48] and having a key worker system with key worker's duties involving screening[41].

Integrating care across health settings: Seven studies[29-31,40,42,44-45] were developed to evaluate and reduce the fragmentation of care between different care providers. New clinics to improve physical healthcare were set up and evaluated[29-31], two trials[44-45] evaluated nurse-led care management and two studies audited improvement in awareness[42] and communication[40] within the multidisciplinary care coordination team. All reported improvement in physical health monitoring or uptake of screening tests post intervention. Two studies[44-45] were rated as good quality. One study[44] reported improvement in cardiovascular disease risk among intervention subjects of an effect size comparable to that seen in underserved populations without mental illness. Barriers to the successful implementation of the intervention included lack of coordination across the primary and secondary care interface[30,45]; patient reluctance to attend appointment/undergo screening[29,42]; staff resistance to change[40,45] and lack of a prescribing provider[44]. Facilitators included team investment in screening procedure and stakeholder involvement[29,31,40,42]; psychosocial support and trust between patients and staff to help them obtain screening[29,44] and availability of primary and specialist care[29,30,42,45].

Staff accompaniment to appointments: Four studies[29,33,40,44] included accompaniment of service users to appointments as part of their intervention. This type of intervention addresses potential difficulties in locating and visiting unfamiliar places which has been reported as a barrier to cancer screening uptake by some service users[18]. One study[33] from Supplementary Table 1 was added to this cluster as it included staff accompaniment to screening. Barriers to the successful implementation of the intervention included staff workload issues[33,40]; difficulty to engage staff[33,40]; patient reluctance to undergo screening[29,33] and difficulty to obtain an appointment/appointment non-adherence[29,33]. Facilitators included staff feeling invested/having a sense of ownership with regard physical health screening[29,33,40]; having access to primary care/in-home phlebotomy services[29,33,44] and trust between clients and staff[29,33].

DISCUSSION

Statement of principal findings

A large international body of work was identified with diversity in the number of physical health conditions and clinical settings. Challenges to increase uptake of physical health screening and monitoring in people with SMI was not unique to a particular country, setting or health service

configuration. The studies illustrate that people with SMI come into contact with a number of different health services. Two tools to facilitate screening[35,39] and two health service delivery change[26,40] interventions were delivered in primary care. The remaining took place in inpatient and outpatient mental health services. Mental health staff performed 'in-house' screening[28,31,36,37,43,46,48], ordered screening tests[30,31,32,33,34,38,41,42,43,45,47] or acted as a broker between the patient and screening service[29,33,41,44]. Overall there appears to be no strong evidence as to whether an intervention to increase uptake of screening would be better suited in primary or secondary care. Performing 'in-house' screening in mental health services rather than in a primary care context warrants further research, including what training and equipment this requires. In addition, mechanisms to establish and maintain strong links between primary care/screening clinics and mental health services to ensure patients attend screening appointments, appear central to monitoring patients' physical health.

Identified barriers to the successful implementation of tools to facilitate screening can be clustered into resource constraints, environmental barriers, unclear boundaries around professional role and a perceived lack of professional skills and training. Authors in several studies[33,34,37,38,39,47] noted a number of logistical and resource constraints to the successful collection of measurements due to limited staff time[32,33,35,38] and difficulty accessing monitoring equipment (such as specific WC tool for obese patients and access to BP monitors in CMHTs). Staff also reported difficulties capturing monitoring results onto the tool[28,32,38,39] (e.g. complicated guidelines to follow). Other barriers included patient resistance to exploring sensitive topics such as sexual health, and transportation, cultural and language barriers to access phlebotomy clinics and arranging an appointment.

Authors in several studies[32,33,36,37,38,47] noted low uptake of invasive test measurements e.g. WC, fasting (BG) and appointment non-adherence to cancer screening and MS monitoring. Lack of integrated care between mental health services and primary care[33,34,37,38] for treatment and referral post-diagnosis was another barrier. Some mental health staff were reluctant to see MS screening as their responsibility[32,33], leading to resistance to engage in this activity. The lack of training to collect WC data in a uniform way, and unawareness of a potential 'social desirability bias'[28,36], lead to the risk of unreliable results. Lastly, a perceived lack of expertise from mental health professionals to interpret physical health results[34,37] was raised as a potential barrier.

Several facilitators to the successful implementation of tools to facilitate screening were identified, including staff feeling invested and having a sense of 'ownership' in physical health

monitoring[33,36,37,39], staff flexibility around taking measures by using alternative (e.g. less invasive) equipment and tests[33,39] and having a clinical psychiatric pharmacist[37,47] on the ward to support mental health professionals e.g. by reminding staff to request blood tests and provide the relevant guidelines and precautions to follow when hypolipidemic agents are prescribed.

Barriers to the successful implementation of health service delivery changes are clustered into resource constraints, environmental barriers, unclear boundaries around professional role and patient resistance. Authors note lack of time[33,40,47] for health professionals to allocate to screening as a barrier as well as staff turnover[43,46] and other resource constraints[41,44,47] such as lack of screening equipment and a prescribing provider. Environmental barriers include lack of coordination across the primary and secondary care interface[30,41,43,45] and difficulty for patients and staff to obtain a screening appointment[29,33]. Reluctance to engage in screening was observed from the clinician and patient perspective. In staff, limited clarity over who takes responsibility for screening[41,48] was a barrier, as well as difficulty to engage staff[33,40] in the project, staff resistance to change[40,45,46] and staff not perceiving physical health screening as a priority[41,46]. In patients, reluctance to engage with screening was identified as lack of motivation/skepticism in the screening process[41,46], appointment non-adherence[29,33,42] and particular resistance to invasive tests[42,46].

Facilitators to the successful implementation of health service delivery changes include having team 'champions' or a key worker to encourage screening, having staff that feel invested/a sense of ownership with regard physical health screening[29,33,40,41,42,47], stakeholder involvement[29,31,40,42], having strong links to primary care and specialist services[29,30,33,42,45,48] including at-home phlebotomy services and established trust between clients and staff[29,33,44]. Barriers to the successful implementation of tools and health service delivery changes to facilitate screening include workload issues, resource constraints such as difficulty accessing monitoring equipment, patient resistance to screening and difficulty in arranging an appointment, fragmented links between primary and secondary care, unclear professional role boundaries for screening and staff resistance to engage in screening. Facilitators to the successful implementation of tools and health service delivery changes to facilitate screening include staff feeling invested and a sense of 'ownership' to engage in physical health monitoring.

The quality of data identified was generally low, it is therefore not possible to determine the size of effect any intervention may have. Different interventions may target different aspects of screening and different barriers and facilitators may apply. However, the high level of heterogeneity and the

limited quality of evidence meant that it is not possible to draw firm conclusions. Several potentially useful intervention approaches were identified however. A key aim of this review was to identify what approach worked for whom. However, this was not achieved since few studies tested this. Nevertheless, the review identified specific barriers and facilitators to screening uptake or access in people with SMI which should be considered in future studies.

Future studies should be reported using the TiDieR guidelines[52] and Medical Research Council (MRC)[53] guidance to make explicit how the components of complex interventions may work. Similarly, use of behaviour change theory was considered in one intervention design[43] – some studies acknowledged it was not considered – which provides no insight into what might have impacted on staff and service user behaviour to increase uptake. Few interventions were designed in collaboration with service users, nor were their preferences explored.

There are no longitudinal studies therefore this review is unable to clarify if screening is maintained post intervention and whether the increase in uptake is sustainable or a consequence of the Hawthorne effect whereby health professional behavior reacts to being observed. An evidence gap was identified as only three studies[31-32,46] reported on whether the results of screening were acted upon, for instance through referral or clinical intervention. One study[33] aims to make annual MS screening a 'routine responsibility' for the mental health team but acknowledges it cannot refer patients to primary care.

Study limitations

There is inconsistency around how terms such as 'screening' and 'monitoring' are used which hampers comparative exercises. Our method of deploying them may differ to that of others who may use different terms and include different studies. To compensate for this, and in line with realist review methodology, we used a broad and inclusive study identification process which we adapted iteratively through the study selection process, as described above. We identified a wide range of studies with varied participants, settings, interventions and intervention targets; a narrower review may provide answers which are more applicable to particular situations, however, the lack of good quality evidence identified suggests that this is unlikely to be the case.

CONCLUSION

Policy implications

Interventions to reduce patient and health professional resistance to screening which are informed by behaviour change theory should be developed and tested. Strategies to improve coordination between primary and secondary care are also needed, as are guidelines to clarify professional role

boundaries. Resource constraints such as staff time and lack of monitoring equipment in mental health settings need to be addressed in the various clinics where screening occurs. Involving service users in intervention design is also important so that their preferences for location, frequency and type of support can be identified and targeted. Consideration of how interventions are likely to work should be made during development and testing.

A. Contributors: EB, CB, SC and DT were involved in the study design. EB, MGH, FLG, AM and DT acquired and analysed the data. EB, SC, FLG and PW interpreted the data. FLG and AM drafted the manuscript. CB, SC, FLG and PW critically revised the manuscript for intellectual content. EB, CB, SC, MGH, CG, FLG, AM, DT and PW contributed to writing and interpretation of the results.

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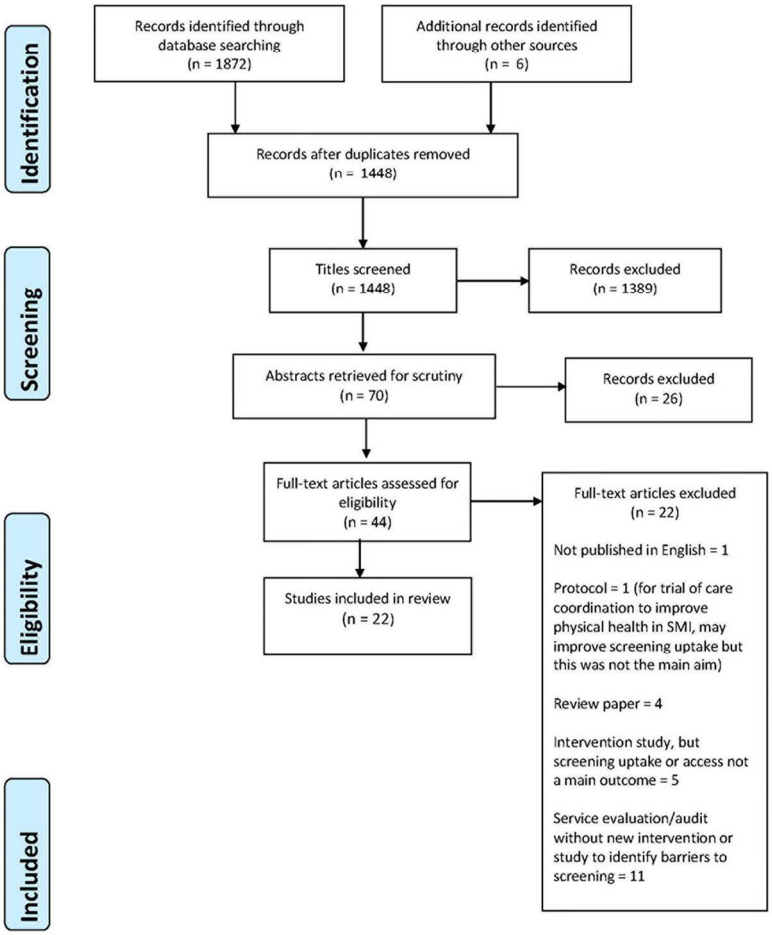

Figure 1. PRISMA Flow Diagram of intervention studies included and excluded from this review

104x147mm (300 x 300 DPI)

Appendix

1. Search terms used in search strategy

The following terms will be used in all data sources: (cardiovascular OR vascular OR CVD OR 'chronic heart disease' OR 'coronary heart disease' OR CHD OR diabetes OR metabolic OR aneurysm) OR cancer OR neoplasm OR carcinoma OR maligna* OR *tumour OR tumor OR breast OR mammogra* OR bowel OR cervical OR pap*) OR (dental OR dentist OR tooth OR teeth) OR (eye OR retinopathy) AND ('mass screening' OR surveillance*) OR "Screening Test" OR ((cholesterol OR fecal OR faecal OR blood OR HIV OR sig¬moid OR tuberculosis) AND test*) OR "health check*" AND (letter OR mail* OR phone OR telephone OR 'reminder system*' OR 'videotape recording*' OR 'audiotape recording*' OR questionnaire* OR strateg* OR alert* OR hotline OR community OR media) AND (intervention* OR goal OR 'behav* change' OR 'implementation intention*' OR plans OR planned OR planning OR plan OR educat* OR campaign* OR barriers OR intention* OR 'behav* outcome' OR outcome OR 'lifestyle change' OR longitudinal OR 'follow up' OR motivation*) AND (satisf* OR dropout* OR 'drop out' OR attrition OR uptak* OR adher* OR compliance OR complie* OR comply* OR 'patient acceptance of health care' OR encourag* OR improve* OR improving OR increas* OR promot* OR particip* OR nonattend* OR 'non attend' OR accept* OR attend* OR attitud* OR utilisation OR utilization OR refus* OR respond* OR respons* OR reluctan* OR nonrespon* OR 'non respon*' OR incidence OR prevalence OR prevalence OR satisfaction OR cooperat* OR 'co operat*') AND ('severe mental illness' OR 'mental illness' OR schizophrenia OR catatonic OR paranoid OR disorganized OR disorganised OR bipolar OR manic OR psychosis OR psychotic OR psychiatric OR schizophrenic OR SMI)

Table 1: Tools to facilitate screening

Study	Year	Country	Population Studied	Intervention	Screening			Method(s) applied	Results	Main study weaknesses
					Type of screening (targeted or with multiple parameters)	When, how and where in the care pathway was screening offered	Screening health professional(s) and type of service			
Bressington et al28	2014	Hong Kong	148 community based psychiatric service users	Training for community psychiatric nurses on how to use the HIP and how to conduct the required physical examinations	The Health improvement screening tool (HIP) contains 27 gender specific items designed to highlight indicators of physical health risk in people with SMI. Items are divided into four categories: measurements, blood tests, screening and lifestyle	The HIP was used as a screening tool at baseline and repeated at 12 months follow-up during routine clinical practice	Community psychiatric nurses trained to use the HIP in a community mental health clinic in Hong Kong	Consecutive prospective case series design Pre-post evaluation of structured questionnaire as a screening tool for physical health problems	Significant improvement in self-reported levels of exercise and reduced prescriptions for mean waist circumference increased at follow-up but may be due to measurement error (87.32 to 89.90) Lack of deterioration in most areas of cardiovascular risk (BMI mean: 25.79 to 25.66, weight	No randomization, no control group Selection bias

									mean: 66.76 to 66.49) Reduction in medicines prescribed for physical health problems: diabetes medication (p = 0.04) and prescriptions for hypertension reduced at follow-up from 21% to 14% of patients General improvements in health behaviours over the 12 month period: 7% increase in number of patients eating sufficient fruit and vegetables, but only exercise improved to a statistically	

									significant level (p = 0.02)	
Castillo et al[33]	2015	USA	141 community based assertive outreach service users	Systematic screening protocol for MS and educational sessions for staff and service users	Metabolic syndrome screening (waist circumference, blood pressure, fasting blood glucose, triglycerides, and high density lipoprotein cholesterol)	Blood tests were ordered for metabolic monitoring when clinicians prescribed scheduled second generation antipsychotics (SGAs) to their inpatients. During routine clinical practice, patient waist circumference was measured and blood pressure was measured using the standard	Nurses and psychiatrists working in three Assertive Community Treatment (ACT) teams in New York. ACT social workers and case managers facilitated patient screenings as needed by scheduling and accompanying patients to appointments, arranging transportation and liaising with primary care providers and blood test clinics	Quality Improvement	75 (53%) participants met criteria for MS Five of these diagnoses came from use of adapted diagnostic criteria using random glucose measurements Of the 66 participants who did not have MS, only 9 had no metabolic risk factors 34 met 2 criteria and the remaining 23 met 1 criterion for MS	No randomization, no control group

						size adult blood pressure cuff available at each ACT site. Measurements were typically conducted in patients' homes				
Delmonte et al[47]	2012	USA	Service users on SGAs on a general psychiatric inpatient unit – 171 at pre alert and 157 post alert. Patients receiving SGAs on an as-needed basis only were excluded	Use of computerized electronic patient alerts to enhance metabolic monitoring	Metabolic monitoring (fasting blood glucose and lipid). Patient weight, blood pressure, information regarding family history and waist circumference were not collected as part of this study	Prescribers entering an SGA order assess the need for metabolic monitoring, and facilitate ordering of appropriate blood tests directly via the electronic pop-up alert	Clinicians prescribing scheduled SGAs at a University Hospital inpatient psychiatry unit in Michigan	Retrospective chart review of notes and tests ordered to assess for MS Pre-post study design	Significant difference in availability of metabolic monitoring data post intervention: 12.9% to 47.8% in number of service users with both fasting glucose level & fasting lipid panel	No randomization, no control group Open to time bias

Gonzalez et al[34]	2010	UK	Male and female community based service users taking regular antipsychotic medication Inner city London population First audit N=126 Second audit N=106 No significant difference in demographic details of both samples	Local adaptation of clinical guidelines Implementation of monitoring tool: A4 page filed in the patients' records, both as a prompt to doctors regarding their patients' need for the physical monitoring and as an instrument to facilitate later data collection	Blood tests for patients taking first-generation antipsychotics (full blood count, urea and electrolytes, liver function test, thyroid function test, glycosylated haemoglobin, prolactin, glucose and lipids)	Routine blood testing ordered by psychiatrist every six months for patients on first generation antipsychotics	Psychiatrists in an inner city London borough community mental health centre	Retrospective audit of patients' clinical records for physical health monitoring Systematic randomization by selecting every 4th file in alphabetical order until 25% of caseload was selected	Post intervention: significant improvement in all tests (glucose: 24.6% to 72.6%, lipids: 7.1% to 52.8%, liver function: 38.9% to 79.2%) except HbA1c (3.2 to 5.7%) and Prolactin (0.8% to 0) Implementation of the monitoring tool achieved in 48% of re-audit sample	No randomization, no control group Did not include other measure for detection of MS and did not include ECG Limited time between audits to allow embedding of the intervention Other factors may have resulted in improvements seen due to increased awareness within the service due to local policy and national guidelines or other potential factors
Hardy et al[35]	2014	UK	400 community based service	Two-hour training for practice nurses to	Screening for cardiovascular (CVD) risk factors (blood	Screening for CVD risk factors were	Practice nurses in five primary care centres in Northampton	Repeat audit to monitor how well primary care	Training practice nurses on CVD prevention	No randomization, no control group

			users with SMI	increase level of screening for cardiovascular disease (CVD) risk factors with lifestyle counselling (health check includes seven elements)	pressure, body mass index (or waist circumference), blood glucose, serum cholesterol, diet advice, exercise recommendations and smoking cessation guidance)	carried out by practice nurses as part of their routine clinical role		practitioners are screening people with SMI for CVD following training	increased number of service users receiving wide ranging health check Pre-training: *n* = 33, 8% Post-training: *n* = 60, 15%, *p* = .01 Increase in number of service users receiving lifestyle interventions	Unclear why other 26 primary care centres did not participate Did not look at any other factor (e.g. other training, professional development, targets by the organisation) which could have influenced staff Possible Hawthorne effect and no exploration of whether increased screening improves patient outcomes
Kioko et al[32]	2016	USA	100 notes of community mental health service users aged	Recommended MS monitoring and screening tool to improve	Metabolic syndrome screening (blood pressure, weight, height, lipid panel,	During routine consultation at the clinic with patients on SGA, blood	Mental health clinicians in a local community mental health	Pre-post intervention design to evaluate the effectiveness of using a recommende	Percentage of blood tests ordered were 62% post-intervention compared to	No randomization, no control group Difficulty obtaining waist circumference - parameter

			19 years and above on second generation antipsychotics	identification of patients at risk of MS	fasting glucose and/or glycated hemoglobin parameters)	tests were ordered and vital signs obtained and the results recorded in the patient electronic health system	facility in a southwestern state	d MS monitoring and screening tool to improve identification of MS risk for service users	22% pre-intervention	frequently omitted Lack of agreement over who is responsible for ordering blood tests and following up results Small sample size - difficult to generalize results
Shuel et al[36]	2010	UK	31 community based psychiatric service users 9 Mental Health Nurses 4 Psychiatrists 12 GPs	Paper sheet screening instrument (HIP)	The Health improvement screening tool (HIP) contains 27 gender specific items designed to highlight indicators of physical health risk in people with SMI. Items are divided into four categories: measurements, blood tests,	The HIP was filled out during a consultation with patients on antipsychotics who were invited to attend an outpatient medication management clinic at the hospital	Mental health nurses trained to use the HIP in a nurse-led outpatient medication management clinic, for community adult patients with serious mental illness in Scotland	Retrospective audit of patient and clinician views using semi-structured interviews	Thirty-one patients participated in Audit Mean number of parameters per patient requiring intervention was 6.1 and a total of 189 physical health issues were identified At least one physical health issue was identified per patient	No randomization, no control group One-year FU assessment planned to assess changes in modifiable factors identified by the HIP

					screening and lifestyle				High prevalence of obesity, poor diet (41% of patients) and lack of exercise 14 referrals for potentially serious conditions including raised glucose and lipids, hypertension and cardiac problems	
Vasudev et al[37]	2012	UK	15 male inpatients on a medium secure forensic psychiatric rehab unit diagnosed with SMI and on antipsychotics	Introduction of a physical health monitoring sheet by the Trust to prompt staff to do the checks	Physical health monitoring (weight, BMI, waist circumference, BP, results of blood tests and ECG, diabetic status if suffering from cardiovascular disease, smoking status, calculated	Six-monthly physical health monitoring of all patients in a secure long stay psychiatric unit	The key nurse took responsibility for completing the section on weight, BMI, waist circumference, BP and smoking status while the rest of the information was completed by the junior	Pre-post audit of physical health monitoring (twelve months apart)	At re-audit 100% of service users had up to date records on the physical health monitoring sheet At follow-up increased number of service users prescribed hypolipidaemic agents Significant	No randomization, no control group Small male-only sample Type of ward and environment could influence patient engagement and motivation

					cardiovascular risk over the next ten years, and use of alcohol in units per week)		doctor in a male medium secure forensic psychiatric rehabilitation unit		reduction in CVD risk at follow up	
Wiechers et al[38]	2012	USA	206 adult service users of a psychiatric resident outpatient clinic who were prescribed any antipsychotics	Metabolic Screening Bundle template Three one-hour education sessions conducted to review antipsychotic medication-associated metabolic abnormalities	Metabolic syndrome screening (blood pressure, BMI, glucose and lipid panel)	Documentation in the last 12 months of any individual element of the Metabolic Screening Bundle (blood pressure, BMI, glucose and lipid panel) for patients on antipsychotic medication	Psychiatry residents in an academic medical centre outpatient psychiatry clinic	Audits of the Electronic Medical Record completed at baseline and each quarter for the following year Quality Improvement	Rates component parts of the Metabolic Screening Bundle in the preceding 12 months increased from baseline audit through the Quarter 4 audit: BMI 5% to 44%; BP 4% to 39%; Fasting glucose 15% to 55%; Fasting lipid panel 14% to 55%	No randomization, no control group Chart audit unable to capture undocumented results/results documented other than psychiatry notes that may have been reviewed by the resident but not remarked on in the progress-note Unclear whether gains made with intervention and cohort of residents can be sustained without a dedicated group

										of residents championing change
Yeomans et al[39]	2014	UK	335 service users on the primary care SMI register	GP practices received 30-minute staff training on how to use a computerized physical screening template designed for annual health checks	Physical health review (systolic blood pressure, BMI, high-density lipoprotein: cholesterol ratio, smoking status)	Annual physical health review performed in primary care during annual check up	GPs performed the review in primary care in the Bradford and Airedale region	Retrospective evaluation of computerized template designed for annual physical health check	23% service users with a computerized template review had data rich QRisk2 compared QRisk2 scores above 20% seen in 3.9% of template based reviews Use of template increased detection risk for CVD	No randomization, no control group Method dependent on accurate record keeping and clinician behaviour No record of unrecorded activity taking place which would contribute to annual patient review GPs selected patients for review: possible bias acknowledged but considered unlikely Quality and Outcomes Framework incentive for annual health checks removed

										and replaced by CQUIN.

Table 2: Studies of health service delivery changes

First Author	Year	Country	Population Studied	Intervention	Screening			Method(s) applied	Results	Main study weaknesses
					Type of screening (targeted or with multiple parameters)	When, how and where in the care pathway was screening offered	Screening health professional(s) and type of service			
Abdallah et al[40]	2016	UK	95 service users with schizophrenia living in care homes	Patient education and education of care home staff	Physical health monitoring (blood workup, liver function test, urea and Electrolytes, full blood count, fasting blood glucose, blood lipid, HbA1c, prolactin, blood pressure/pulse/weight measurem	Physical health screening was offered during the Care Programme Approach review (held every six months to one year)	Screening was done by GPs. Patients were attached to the Haringey Community Rehabilitation team (multidisciplinary care coordination team that includes mental health nurses, social	Quality Improvement	Improvement in culture within care home where staff and service users actively participated in physical health monitoring Blood pressure and weight measured in 68% of patients compared to 10% and 0 at baseline 55% of patients had pulse measured compared to 0 at baseline	No randomization, no control group Small sample, difficult to determine results as in later PDSA cycles the interventions did not target only the patient group included in the results

					ent, BMI, waist circumference)		workers, psychiatrists, psychologists, and mental health care assistants)		68% had bloods done compared to 0 at baseline	
Druss et al[44]	2010	USA	407 service users with SMI under care of community teams	Participants with SMI at an urban community mental health centre were randomly assigned to either the medical care management intervention or usual care For individuals in the intervention group, care	23 indicators drawn from the U.S. Preventive Services Task Force guidelines were included across the following four domains: 1) physical examination (blood pressure, eye, height/weight, oral, breast, mammogram, and pelvic)	Care managers supported patients to get screened by providing communication and advocacy with medical providers, health education, and support in overcoming system-level fragmentation and barriers to primary	Care managers (registered nurses) assisted patients from an urban community mental health centre in Atlanta to access primary care services	Randomized Control Trial	12-month follow-up evaluation: intervention group received average 58.7% of recommended preventive services compared with 21.8% in usual care Significantly higher proportion of evidence-based services for cardio-metabolic conditions (34.9% versus 27.7%) Higher likelihood to	Low risk of bias (Performance bias as control group - treatment as usual - not blinded) Broad entry criteria limited the statistical power to examine outcomes for individual medical conditions Study was conducted in a single site so replication would be needed to fully assess generalizability to different types of community

				managers provided communication and advocacy with medical providers, health education, and support in overcoming system-level fragmentation and barriers to primary medical care	2) screening tests (cholesterol, fecal blood, HIV, sigmoid, and tuberculosis) 3) vaccinations (influenza, hepatitis B, measles, mumps, and rubella, pneumococcal bacterial infection, tetanus-diphtheria, and varicella) 4) education (exercise, self-examination, smoking,	medical care			have primary care provider (71.2% versus 51.9%) Intervention group showed significant improvement on SF-36 mental component summary (8.0% [versus a 1.1% decline in the usual care group]) Scores on Framingham Cardiovascular Risk Index significantly better in intervention group (6.9%) than usual care group (9.8%)	mental health settings

					nutrition, and weight)					
Hardy & Gray[26]	2012	UK	92 community service users with severe and enduring mental illness 338 service users with diabetes	Retrospective comparison of response rate of patients with SMI and diabetes to an invitation appointment letter to attend a primary care health check Patients with SMI sent an appointment at a predetermined time and date. Annual health check for	HIP for primary care: review of any pre-existing co-morbid physical health problems, screening for emergent diabetes, hypertension and dyslipidaemia, initiation of appropriate treatment for newly diagnosed conditions, providing information about co-	Patients with SMI were sent an appointment letter 10 days before the appointment inviting them to attend a primary care health check with a predetermined date and time	Practice nurses in primary care	Retrospective audit	66% service users with SMI attended appointment 81% service users with diabetes attended appointment Service users with diabetes 2.2 more likely to attend health check	No randomization, no control group Unclear if sample reflects whole population of SMI (or diabetes)

				patients with SMI followed the HIP guidance	occurring physical health problems, lifestyle advice (diet, exercise, smoking, alcohol, sex and guidance about self-examination (breast, testicles)), prompt that eyes and teeth have been tested/ checked; review of psychotropic medication and side effect check.					

Heyding et al[29]	2005	Canada	Disadvantaged women aged 50-70 who attended inner-city drop-in centre (N = 158 in 1995-2001 and N = 89 in 2002)	Drop-in centre and nearby hospital in Toronto initiated collaborative breast cancer screening project in which staff of drop-in centre accompanied small groups of women for mammography visits at weekly pre-arranged time	Screening mammography	A staff member of the drop-in centre accompanied small groups of women aged 50-70 for mammography visits at a weekly pre-arranged time	Staff member of an inner-city drop-in centre in Toronto accompanied small groups of women to St. Michael's hospital women's health care centre for mammography screening. A family physician working at the drop-in centre served as the referring physician requesting the mammogram	Pre-post audit Comparison between screening before and after intervention year	Increase from average of 4.7% women receiving a mammography to 29.2%	No randomization, no control group Observational rather than experimental design Limited control over extraneous variables Audited documentation may have been inaccurate or incomplete

Latoo et al[41]	2015	UK	52-55 service users receiving antipsychotics in Early intervention in Psychosis service	Advancing Quality Alliance design to examine six physical health parameters: weight, height, BMI, BP, blood glucose and serum lipids	Comprehensive physical assessment (serum lipid profile, blood glucose, body weight, height, BMI and blood pressure). Other information was collected such as smoking, diet, exercise, sexual health, sleep, dental and optical health, ECGs and other routine blood checks	Notification list alerted on the computer when screening was due. Access to blood tests for both localities was established to help facilitate prompt access to blood results. Wellbeing nurse-led clinics were held in Halton and a social worker- led physical health clinic was initiated in Warrington	Patients were recruited from the Warrington and Halton Early Intervention in Psychosis Service. Screening took place in primary care and physical health clinics (wellbeing nurse-led clinics in Halton and a social worker- led physical health clinic in Warrington)	Retrospective review of clinical records following improvement in physical health monitoring	Screening and monitoring of six parameters: At 4 weeks 29 patients recorded screening, 19 (66%) of which had six types of screening At 24 months, out of 16 patients who had their screening recorded, 15 (95%) had 6 types of screening	No control group No randomized design to test new screening and assessment method

Millar[31]	2010	UK	152 community based service users 100 inpatient and community service users all prescribed antipsychotic medication	Dundee Health Screening Clinic developed to address needs of this population by monitoring physical health and providing follow-up to ensure that patients received necessary care	The Health Screening Clinic included three main types of clinical investigations: 1) physical examination, ECG, and blood screening 2) rating scales with medical/ drug histories and 3) diet and lifestyle advice	MS audit of 152 community-based patients to quantify their physical health problems. A database was set up to record the measurements completed within the Clinic. Results were collected and appropriate follow-up was organised through primary care or specialist services.	Staff at the Dundee Health Screening Clinic (community setting with a multidisciplinary team drawn from the Community Mental Health Team and day hospital staff). Nursing staff were trained in blood letting, measuring blood pressure and waist circumference and completing ECGs.	Mixed Methods: pilot study, audit and satisfaction survey	Heavy burden of physical health problems identified in Phase One (66% obesity, 60% elevated cholesterol, 32% hypertension) Of the first 100 patients audited: 33% had MS 99% agreed health screening important 65% reported lifestyle change	No randomization, no control group Generalizability may be limited due to differences in availability of resources in different areas, though no additional resources were used to develop the intervention

Osborn et al[45]	2010	UK	121 service users under the care of a community mental health team	Nurse-led screening programme and education pack regarding appropriate screening for cardiovascular disease (CVD) related risk factors	CVD screening (including smoking, blood pressure, random blood glucose and lipids)	The intervention established a system to monitor whether CVD screening had occurred for CMHT patients and sent prompts to primary and secondary care staff if screening had not occurred. The nurse offered screening to cover patients who still had not received the complete	Within the intervention arm, approximately half the screening was performed in general practice and half by the trial registered general nurse with previous experience of providing cardiovascular screening	Cluster Randomized Feasibility trial	After the trial CVD screening increased in both arms but participants from intervention arm were significantly more likely to have received screening for blood pressure (96% vs 68%), cholesterol (66.7% vs 26.9%), glucose (66.7% vs 36.5%), BMI (92.5% vs 65.2%), smoking status (88.2% vs 57.8%) and have 10 year CVD risk score calculated (38.2% vs 10.9%)	Low risk of bias Response rate in the recruitment for outcome data was main limitation Recruitment was time limited because of funding Participants who provided outcome data may have been a biased sample of CMHT patients therefore generalization of results is difficult

						battery of CVD screening				
Rosenbaum et al[46]	2014	Australia	60 service users on inpatient psychiatric ward 25 mental health nurses	Educational training including waist circumference (WC) measurement Change in assessment-form design	WC measurement	Over a nine month period, file-based reminder for nurse-assessed WC measurement of mental health inpatients within a private psychiatric facility	Mental health nurses working in a private psychiatric hospital in Sydney	Pre-post audit of the frequency of WC Documentation before/after intervention	Improved measurement by nurses of WC from 0-58% WC was higher in these patients than general population 19% had BMI within a healthy range, 37% smoked, 31% were hypertensive	No randomization, no control group Not all staff were able to receive intervention
Thompson et al[43]	2011	Australia	118 files of service users on antipsychotics under the care of Early Psychosis and Prevention Centre service	Educational intervention for staff Development of local guidelines, provision of	Weight and metabolic monitoring (height and weight to estimate BMI, systolic and diastolic blood pressure, waist and hip	Equipment required to undertake monitoring (e.g. scales, tape measures, blood pressure cuffs) was located in each	Psychiatrists working in an Early Psychosis Prevention and Intervention Centre in Melbourne	Pre-post audit of completion of metabolic screens	Improvements in screening and monitoring of four metabolic indices at the post-intervention time point Individual rates were higher for screening (74.4% to	No randomization, no control group Naturalistic setting

				monitoring equipment, prompts in patients' records and regular reviews	circumference (to obtain waist-hip ratio), fasting blood glucose, full fasting blood lipid profile (including total cholesterol, low and high density lipoprotein and triglycerides), number of cigarettes smoked daily and level of daily exercise	psychiatrist ' s room. Stamps that indicated the necessary blood tests for monitoring were placed in the psychiatrist s ' rooms to aid ordering and completion of the correct blood investigations. Metabolic screening within 6 months of being prescribed an antipsychotic and			84.9%) than monitoring outcomes (24.4% to 41.6%) Rates ranged between 17.4% for blood lipids to 34.9% for obesity measures	

						metabolic monitoring between 1 and 6 months following initiation of antipsychotic medication. Regular review of a patient's metabolic status was built into the clinical review process which occurs on a 3-month basis for all patients				
Vasudev & Martindale[42]	2010	UK	66-72 service users aged 14 to 35 under care of Early Intervention service	In-house training for members of the Early Intervention Service	Annual physical health check (weight, blood pressure, blood	Mental health clinicians address physical health with patients during	Patients in Early Interventions in Psychosis service in Sunderland were	Pre-post audit	Number of patients having at least one annual physical health check increased from 20% to 58%	No randomization, no control group Focuses on Early Intervention so many people do not have a formal

			for more than a month	Interventions between audit – in-house training, physical health mandatory component on care plan review, joint responsibility for communicating with GP, referral information updated to include physical health, liaison with wider MDT	sugar, lipids, electrocardiogram (only done if patient at high risk due to young patient age), full blood count, urea and serum electrolytes, liver function tests and prolactin)	clinical practice and letters are sent annually to GPs to remind them to conduct the physical health checks (study audited this process)	recruited; screening takes place in primary care		Patients who had undergone physical health check at re-audit, a record of some/all of the checks was available in the notes for 75% of patients	diagnosis of SMI e.g. schizophrenia Only 7 months between audits, therefore very short time to measure long term impact

Wilson et al[48]	2014	Australia	107 to 232 service users attending clozapine clinic	Six education sessions covering test interpretation, MS, diabetes management, obesity, smoking cessation and lifestyle interventions "Let's Get Physical" initiative – designation of two months annually as physical health months (PHM) during which time	Metabolic monitoring (including fasting blood glucose, lipids, BMI, girth)	Metabolic monitoring occurs in May and November (designed as 'physical health months'). In the months preceding May and November, investigation order forms were attached to charts for provision by administrators, written information about investigations was provided to patients during consultations, and necessary	Patients on clozapine and staff at Metro North Mental Health – Royal Brisbane and Women's Hospital, which provides assessment and specialist services to a socio-economically diverse population in Brisbane	Quality Improvement Mixed Methods	Completion rates of metabolic monitoring: 69.2% at first month and 65.1% at second month Limited evidence of actions post results	No randomization, no control group Limited possibility of generalization due to single site and very specific population

				revised service protocol required metabolic monitoring for all eligible patients Service protocols were revised to require metabolic monitoring of all eligible patients during PHMs		equipment was placed in consulting rooms. In May and November, a proforma for recording test results and lifestyle assessments (smoking, exercise, alcohol intake) were attached to charts, and clinic appointments were extended from 20 to 30 minutes				

Xiong et al[30]	2015	USA	Patients were receiving outpatient mental health treatment at four mental health clinics in California	Comparison of preventive services used in an integrated behavioural health primary care clinic with two existing community mental health programmes	Cancer services included the following tests/procedures: mammogram, Papanicolaou test, prostate specific antigen test, digital rectal exam, fecal occult blood test, and flexible sigmoidoscopy or colonoscopy. Metabolic profile included blood pressure, height and weight, cholesterol, and blood	Psychiatrists made referrals to primary care doctors for screening in routine clinical practice	Screening was undertaken by various clinical staff and took place in primary care (via referral from two community mental health clinics) and in an Integrated Behavioral Health Primary Care programme housed in the Sacramento County Primary Care Clinic with access to on-site laboratory and x-ray services	Cross-sectional study comparing use of preventative services 350 surveys	Patients on antipsychotic medication were less likely to use preventive non-cancer services than their comparison group (p = 0.04) Integrated Behavioral Health Primary Care unit associated with higher overall service utilization than a community mental health team ($p < 0.001$)	No randomization, no control group Unable to adjust for confounding factors such as severity of illness

					sugar for diabetes. Infection preventive services included influenza immunization, Hepatitis C Virus and Human Immunodeficiency Virus tests					

PRISMA 2009 Checklist

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

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	6
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Figure 1 PRISMA Diagram
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Tables 1 and 2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Tables 1 and 2
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	N/A
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	Tables 1 and 2
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	10-12
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	12
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12-13
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	13

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097.

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