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Review

Systematic review of integrated models of health care delivered at the primary–secondary interface: how effective is it and what determines effectiveness?

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Abstract. Integrated multidisciplinary care is difficult to achieve between specialist clinical services and primary care practitioners, but should improve outcomes for patients with chronic and/or complex chronic physical diseases. This systematic review identifies outcomes of different models that integrate specialist and primary care practitioners, and characteristics of models that delivered favourable clinical outcomes. For quality appraisal, the Cochrane Risk of Bias tool was used. Data are presented as a narrative synthesis due to marked heterogeneity in study outcomes. Ten studies were included. Publication bias cannot be ruled out. Despite few improvements in clinical outcomes, significant improvements were reported in process outcomes regarding disease control and service delivery. No study reported negative effects compared with usual care. Economic outcomes showed modest increases in costs of integrated primary–secondary care. Six elements were identified that were common to these models of integrated primary–secondary care: (1) interdisciplinary teamwork; (2) communication/information exchange; (3) shared care guidelines or pathways; (4) training and education; (5) access and acceptability for patients; and (6) a viable funding model. Compared with usual care, integrated primary–secondary care can improve elements of disease control and service delivery at a modestly increased cost, although the impact on clinical outcomes is limited. Future trials of integrated care should incorporate design elements likely to maximise effectiveness.

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Introduction

Governments internationally have committed to improving the integration of healthcare services for the growing numbers of people experiencing chronic disease. Models of care that feature vertical integration of health care between primary and secondary–tertiary care (Gröne and Garcia-Barbero 2001) have become a source of interest, especially those that involve both General Practitioners (GPs) and medical specialists. Traditional, siloed, organ-based care approaches have failed to provide the holistic, accessible, 'linked-up' care now required – particularly for the growing numbers of community-dwelling frail elderly (Boyd *et al*. 2005). Canada, the United Kingdom and New Zealand have introduced legislative or policy initiatives to advance integration of primary and secondary care (Eliasoph *et al*. 2007; Ministry of Health 2011; Goodwin *et al*. 2012). In Australia, both the National Health and Hospital Reform Commission report (Australian Government National Health and Hospitals Reform Commission 2009) and the National Primary Care Strategy (Australian Government Department of Health and Ageing 2009) have strongly endorsed the need to redesign the health system towards accessible integrated services, particularly for people with chronic disease.

There are many challenges with such significant service redesign (Australian Government National Health and Hospitals Reform Commission 2009). Not least is the need to ascertain what factors improve the quality, safety or cost-effectiveness of care around the interface between community-based primary care and hospital-based specialist care, specifically for patients with chronic/complex disease like diabetes mellitus.

Different terms have been described for multidisciplinary care. Tieman *et al*. (2007) have described different elements of care that involve multiple providers. Coordination was seen as processes and activities that enhance the relationships, linkages, transitions and responsibility for care within the existing

What is known about the topic?

- There is a small but growing evidence base informing the design and implementation of models of integrated primary–secondary care to manage complex and/or chronic disease.

What does this paper add?

- Potential benefits to patients, clinicians and the health system are more likely to accrue from models of integrated primary–secondary care that demonstrate six key design elements.

structural arrangements such as shared health records, case conferences or shared assessment tools, leading to improved care arrangements for the patient. Integration is the development of more comprehensive approaches to care provision that depend on formal relationships or structural arrangements to organise and deliver that care. Multidisciplinary care is a care approach that addressed complex care needs by utilising a broader set of skills in assessment and ongoing care held by providers from different disciplines, specialties and /or professions who could contribute independently. Another relevant concept is stepped care, which proposes care of increasing intensity depending on the complexity or advanced nature of the condition (Von Korff and Tiemens 2000; Smink *et al*. 2014). For the purposes of this project, we have elected to use the term 'integrated care', as we are interested in the concept of systematic, organised interaction between primary and secondary care.

Considerable work has been done examining integrated, multidisciplinary care. Most of this has focussed on describing interventions at a systematic level, seeking to define the features of this form of care. Ouwens *et al.* (2005) conducted a meta-review of 13 studies that focussed on identifying the characteristics of integrated care that were important in improving the care of chronically ill people, as well as their effectiveness. Martínez-González *et al.* (2014), building on the work by Ouwens *et al.* (2005), conducted a meta-review seeking to identify the principles that facilitate high-quality integrated care.

Others have focussed more on primary care. Gruen *et al.* (2004) conducted a Cochrane review of outreach specialist clinics in primary care and rural settings. They showed that specialist outreach clinics in general practice improved access, but not health outcomes, but more in-depth collaboration with primary care did improve health outcomes, and more efficiently. Singh (2005) sought to identify initiatives that were effective for improving the quality and cost-effectiveness of care for people with chronic illness. She found evidence to support integrated community and hospital care and a greater reliance on primary care, but high-quality evidence regarding the effects of such initiatives on clinical outcomes and healthcare costs was lacking. The Cochrane review conducted by Smith *et al.* (2007) assessed the effectiveness of shared care interventions for improving chronic disease management across the primary–secondary care interface, and found no improvements in patient outcomes except for better prescribing practices, and recommended that shared care models not be adopted widely until better studies, which are longer and whose design take into account the complexity of the interventions, have been conducted.

It is clear that some methods of improving care across the primary–secondary interface are more effective than others. Integrated care, as defined above, involves active negotiation of case assessment and care planning and care delivery between primary care providers and specialists. A gap in the literature exists in examining this form of integrated care between specialists and general practice care in its own right, rather than as a subset of broader cross-disciplinary care strategies.

We undertook a systematic literature review to answer the following question: For adults with chronic and/or complex chronic physical conditions, do interventions that integrate primary and secondary care improve clinical, process and cost outcomes, compared with usual care? A secondary aim was to identify, from descriptions of the workings of the models of care provided in each study, the common organisational and operational elements (design elements) present in models that produced more successful outcomes.

For the purpose of this review, integrated primary–secondary care was defined as vertically integrated models of care for managing chronic/complex chronic disease in individual patients, which involves direct interaction between primary and secondary care providers. We focussed on identifying published models of integrated primary–secondary care that reported pre-specified outcome measures, which allowed comparisons of benefit of different models. We aimed to identify how such care impacts on outcomes for patients, practitioners and the health system, and affects process of care and resource utilisation. We also sought to identify the design elements that underpin effective models of care.

Methods

Eligibility criteria

Studies were included if they recruited adults with chronic/complex chronic disease and compared care models using specialist and primary care medical practitioners working collaboratively across primary and secondary care settings, with usual care. Chronic disease is defined as illness that is prolonged in duration, does not often resolve spontaneously and is rarely cured completely (Australian Institute of Health and Welfare 2012). We searched for English language peer-reviewed studies published between January 2000 and July 2012. Study designs included randomised controlled trials (RCTs), non-randomised or quasi-randomised controlled trials and pre-post studies. We excluded studies focussed on paediatric or oncology models of care because the distinctive needs of these population groups were not germane to our review. Mental health models were also excluded due to their orientation to broader societal issues that are beyond the capacity of the health system and individual patients to control (Germov 2005).

Search strategy

A list of terms and MeSH synonyms was developed by the authors, with reference to the above definition of integrated care models, and were categorised under the following key areas of interest: (1) integrated models of care; (2) primary and secondary care; (3) chronic/complex chronic disease; and (4) outcomes

(Appendix 1). The initial list of search terms was applied to two databases (CINAHL and Medline) to test for relevance. Abstracts of potentially useful studies were read to identify any other relevant search terms. The complete search strategy with all identified search terms was then applied to Cochrane, CINAHL, Medline, PubMed, PsychINFO and Embase databases to identify all potentially relevant studies. We also hand-searched key articles and the reference lists of identified studies.

Study selection

Retrieved studies were assessed independently for inclusion by two co-authors (LB, JZ). In cases of disagreement regarding whether to include a study, a decision was reached by a third reviewer with a clinical background (CJ).

Data extraction and synthesis

Once the final set of studies was selected, information about design, participants and setting, models of care, outcome measures (clinical, process and economic outcomes) were extracted and summarised. As the studies were highly heterogeneous with regard to patients, interventions and reported outcomes, a meta-analysis of quantitative data was not possible and hence results are presented in narrative form using the method of Popay *et al.* (2006). From a qualitative perspective, both the operational barriers and enablers to integrated care, as identified by authors of the papers, were tabulated in an effort to identify the design elements of models of care that demonstrated improved clinical, process or economic outcomes, compared with usual care.

Quality appraisal

The Cochrane risk of bias tool (Higgins and Green 2011) was used to appraise included studies. This tool assesses the studies for the level of risk of the following forms of bias: selection bias, performance bias, detection bias, attrition bias and reporting bias. Risk is assessed as low, moderate or high, and the reviewer is required to explain how that conclusion was reached for each potential bias.

Results

The search produced 1516 hits, and a further 50 hits were identified and screened during the assessment process, as described in Fig. 1.

Study details

The details of included studies are summarised in Table 1. Ten studies (14 papers) involving a total of 7697 patients were included in the review. The majority of studies related to patients with diabetes ($n = 6$; Simmons 2003; Nocon *et al.* 2004; Smith *et al.* 2004; Kirsh *et al.* 2007; Borgermans *et al.* 2009; Askew *et al.* 2010; Goderis *et al.* 2010; Jackson *et al.* 2010). Three were from New Zealand (Doughty *et al.* 2002; Pearl *et al.* 2003; Rea *et al.* 2004; Sheridan *et al.* 2009), two each from Australia (Simmons 2003; Askew Jackson *et al.* 2010; Jackson Tsai *et al.* 2010) and the UK (Nocon *et al.* 2004; Coast *et al.* 2005; Salisbury *et al.* 2005), with the remaining three from the US (Kirsh *et al.* 2007), Belgium (Borgermans *et al.* 2009; Goderis *et al.* 2010) and Ireland (Smith *et al.* 2004). One study was an RCT (Coast *et al.* 2005; Salisbury *et al.* 2005), four were cluster RCTs (Doughty *et al.* 2002; Pearl *et al.* 2003; Rea *et al.* 2004; Smith *et al.* 2004; Borgermans *et al.* 2009; Goderis *et al.* 2010), three reported a quasi-experimental design (Nocon *et al.* 2004; Kirsh *et al.* 2007; Askew *et al.* 2010; Jackson *et al.* 2010) and two used a pre-post design (Simmons 2003; Sheridan *et al.* 2009). Eight studies used quantitative methods (Doughty *et al.* 2002; Pearl *et al.* 2003; Simmons 2003; Rea *et al.* 2004; Smith *et al.* 2004; Coast *et al.* 2005; Salisbury *et al.* 2005; Kirsh *et al.* 2007; Borgermans *et al.* 2009; Askew *et al.* 2010; Goderis *et al.* 2010; Jackson *et al.* 2010), whereas two used a mixed-methods approach (Nocon *et al.* 2004; Sheridan *et al.* 2009).

Study quality

Study quality was mixed, with the RCTs (Doughty *et al.* 2002; Pearl *et al.* 2003; Rea *et al.* 2004; Smith *et al.* 2004; Coast *et al.* 2005; Salisbury *et al.* 2005; Borgermans *et al.* 2009; Goderis *et al.* 2010) demonstrating low to medium risk of bias and the non-randomised trials (Simmons 2003; Nocon *et al.* 2004; Kirsh *et al.* 2007; Sheridan *et al.* 2009; Askew *et al.* 2010; Jackson *et al.* 2010) demonstrating medium to high risk (Table 2). A full appraisal of the risk of bias in the included studies is available in Appendix 2.

Study outcomes

We categorised study outcomes into clinical, process of care and economic, and here we report the quantitative outcomes.

Clinical outcomes

Eight studies reported clinical outcomes (Table 3). In both RCTs and other study designs, there were many outcomes that showed no difference between groups. For the five diabetes studies, there were a few improved outcomes in RCTs and non-randomised studies, but the magnitude of the improvements were larger in the non-randomised studies (Simmons 2003; Kirsh *et al.* 2007; Jackson *et al.* 2010). One RCT showed improvements in wellbeing (Smith *et al.* 2004). In programs for respiratory disease and heart failure, some of the quality of life subscale scores improved (Doughty *et al.* 2002; Rea *et al.* 2004).

Process of care outcomes

Seven studies reported process of care outcomes (Table 4). Patient attendance rates improved in one study of patients with diabetes (Smith *et al.* 2004), and hospital attendances fell in another (Nocon *et al.* 2004). Reported non-attendance rates reduced in one study (Jackson *et al.* 2010), but were worse for intervention clinics in another study (Nocon *et al.* 2004). Nocon *et al.* (2004) also noted increased combined hospital and outpatient clinic usage (Nocon *et al.* 2004). While hospital admission rates fell in the intervention for complex medical patients (Sheridan *et al.* 2009), there was no change in admission rates for patients with chronic obstructive pulmonary disease (COPD; Rea *et al.* 2004) or heart failure (Doughty *et al.* 2002). However, falls in hospital length of stay (Rea *et al.* 2004) and readmission rates (Doughty *et al.* 2002; Sheridan *et al.* 2009) were reported.

There was evidence of improved clinical performance by GPs, with better recording of important clinical information, and better

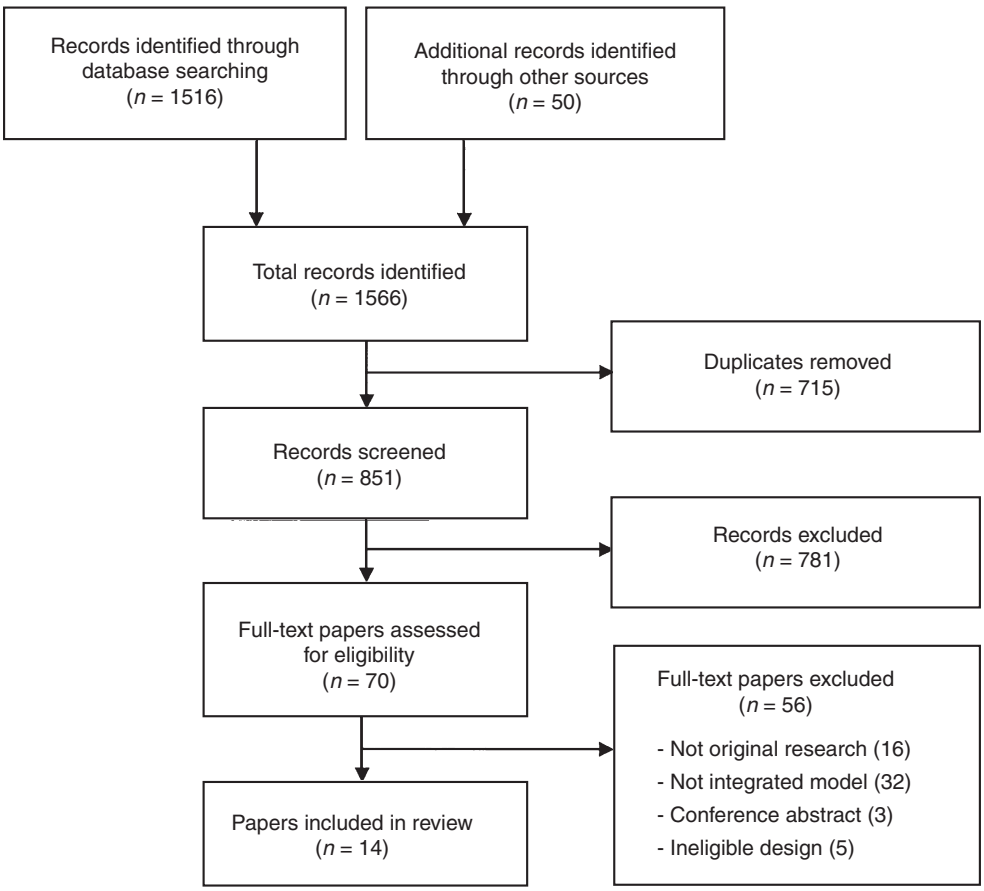

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram of the study selection process (Moher *et al*. 2009).

capture of diabetes patients on practice diabetes registers (Smith *et al*. 2004). There was also evidence of better patient information sharing between sectors (Smith *et al*. 2004). Both clinicians (Pearl *et al*. 2003; Nocon *et al*. 2004; Salisbury *et al*. 2005; Sheridan *et al*. 2009) and patients (Nocon *et al*. 2004; Salisbury *et al*. 2005; Sheridan *et al*. 2009) reported satisfaction with these initiatives, with clinicians holding the view that the interventions improved patient outcomes. There was no clear difference in frequency of reporting of outcomes between RCTs and studies employing other designs.

Economic outcomes

Table 5 reports health economic outcomes, with four studies reporting cost data. Jackson *et al*. (2010) showed a substantial cost reduction of clinic-based care for patients with diabetes compared with hospital outpatient-based care. Other programs showed modest extra costs (Coast *et al*. 2005; Borgermans *et al*. 2009) or no difference (Nocon *et al*. 2004). Only one study calculated an incremental cost benefit for the intervention (Coast *et al*. 2005). Costs were higher for the intervention in both studies that used a RCT design. For studies using other designs, costs were lower for one study and no different to controlled data for the other studies.

Design elements of models of care

While improvements in clinical outcomes were modest, most models showed improved process outcomes, particularly for GPs within the interventions. We reviewed the methods described in the included papers to ascertain the organisational and operational elements of each. We identified six elements that appear to facilitate models of integrated primary–secondary care. The studies in which they were described are shown in Table 6. These elements are: (1) interdisciplinary teamwork; (2) communication and information exchange; (3) the use of shared care guidelines or pathways; (4) training and education; (5) access and accessibility; and (6) a viable funding model. For each element, we identified facilitators and barriers described in each published work.

Element 1: interdisciplinary teamwork

Effective integration depends on the right mix of interdisciplinary health professionals and roles which predisposes to a well-functioning team (Doughty *et al*. 2002; Pearl *et al*. 2003; Simmons 2003; Nocon *et al*. 2004; Rea *et al*. 2004; Smith *et al*. 2004; Kirsh *et al*. 2007; Borgermans *et al*. 2009; Sheridan *et al*. 2009; Goderis *et al*. 2010; Jackson *et al*. 2010). These teams featured good coordination by personnel with an understanding of communityand specialist-based care (Doughty *et al*. 2002;

Table 1. Details of studies of integrated primary–secondary care for managing chronic/complex chronic disease

HbA1c, glycated haemoglobin; IDCT, interdisciplinary diabetes care team; UQIP, usual quality improvement program; AQIP, advanced quality improvement program; SBP, systolic blood pressure; LDL-C, serum low-density lipoprotein cholesterol; GP, general practitioner; GPwSI, General practitioner with a special interest; COPD, chronic obstructive pulmonary disease

Study, location, references	Study design and aim	Participants and setting	Intervention (and control)
Diabetes studies			
Brisbane South Complex Diabetes Service, Australia; Askew *et al.* (2010), Jackson *et al.* (2010)	Quasi-experimental Non-randomised concurrent control group Aim: to assess the impact on HbA1c control of a new model of care for complex diabetes	166 patients referred by their GP to a complex diabetes clinic (intervention) or a hospital diabetes outpatient clinic (usual care)	Intervention $n = 185$: GPs refer patients for specialist assessment to a local 'beacon' general practice with a complex diabetes clinic that is conducted one morning per week and includes a specialist multidisciplinary team including GPs with training in advanced diabetes care, diabetes nurse educators and support from an endocrinologist. Evidence-based guidelines are used; the referring GP receives a management plan within 1 week and a direct contact number to the clinic Control $n = 145$: Hospital-based outpatient service
The Leuven Diabetes Project, Belgium; Goderis *et al.* (2010), Borgermans *et al.* (2009)	Cluster randomised controlled trial Aim: to assess the effects of an IDCT by comparing a UQIP with an AQIP Primary outcomes: HbA1c, SBP, LDL-C	120 Primary Care Physicians and 2495 diabetes patients in a semi-rural region	Intervention $n = 1577$: AQIP involved a detailed shared care protocol and advanced patient, professional and organisation components; for example, involvement of a pharmacist, educator visits practices and homes, four education sessions, group sessions for patients/family, free access to monitoring tools, counselling, structured materials, performance summaries, GP access to case meetings and shared care documents Control $n = 918$: UQIP consisted of multidisciplinary assessments, two education sessions, a standard protocol, standard education materials, clinical reminders and a performance summary Endocrinologists assisted in developing care guidelines and providing case coaching on request from GPs who were encountering problems in treating their patients
Diabetes Shared Medical Appointment System, USA; Kirsh *et al.* (2007)	Quasi-experimental Non-randomised concurrent control group Aim: to improve the intermediate outcomes for high-cardiovascular risk diabetes patients	79 patients with diabetes from a primary care clinic at a tertiary care academic medical centre in the Veterans Healthcare System, with one or more of: HbA1c >9%; SBP >160 mmHg; LDL-C >130 mg/dL	Intervention $n = 44$: the model comprised a sophisticated e-record, an integrated Chronic Care Model (case manager, a recall system, feedback), a patient group consultation with multidisciplinary staff and a one-to-one private component to consultation. The model includes a training component and clinical guidelines Control $n = 35$: normal care, intervention received 12 months later
GPwSI-led specialist diabetes clinics, UK; Nocon *et al.* (2004)	Quasi-experimental Time series and post-intervention (mixed methods)	2067 patients attending 19 specialist GP clinics; 1746 attending the hospital	Intervention $n = 2067$: an initial 2-day GP training was provided, plus optional further workshops with a case discussion component; clinics were supported by a diabetes specialist nurse, allied health and retinal screening; up to four clinics per month were held

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Table 1. (*continued*)

Study, location, references	Study design and aim	Participants and setting	Intervention (and control)
	Aim: to evaluate the effect of a primary care-based approach to diabetes care on outpatient waiting times	19 specialist clinic providers (questionnaire) 24 specialist clinic and other professional staff (interviews) 142 GPs outside the clinic practice (questionnaire) 8 GPs and 2 practice nurses (interviews) 55 patients (interviews)	Control $n = 1746$: hospital-based care
North Dublin Diabetes Shared Care Model, Ireland; Smith *et al.* (2004)	Cluster randomised controlled trial Aim: to assess the feasibility and effectiveness of a structured diabetes shared care service in a mixed healthcare system, and analyse the impact on total patient care	30 general practices (50 GPs) and 183 diabetes patients	Intervention $n = 96$: initial training (a 6-week distance education course) for GPs and practice nurses; a community-based diabetes nurse specialist visited the practices at least monthly; locally agreed clinical and referral guidelines; an annual hospital outpatient review and a 3 monthly GP clinical review; structured records and communication across primary–secondary care interface; a fast track referral process as needed Control $n = 87$: 24% of patients received no structured diabetes care; the remainder attended hospital-based diabetes clinics and were seen on an annual basis only
Rural Diabetes Integrated Care Clinic, Australia; Simmons (2003)	Pre-post intervention Aim: to evaluate the effectiveness of an integrated primary–secondary care diabetes clinic on metabolic control	40 Australian Indigenous patients with diabetes from a rural community	Patient care plans, laboratory results phoned/faxed to specialist, integrated written record includes letter to GP with action plan, accessible to other team members; optional weekly GP/specialist discussion; Aboriginal health worker and other integrated team members led follow up; and staff training
Studies involving other conditions			
Auckland Heart Failure Management study, New Zealand; Doughty *et al.* (2002), Pearl *et al.* (2003)	Cluster randomised controlled trial Aim: to assess the effect of integrated heart failure management on hospital readmissions, patient quality of life and general practice	132 general practices, and 197 hospital in-patients with a primary diagnosis of heart failure who consented before discharge Exclusions: surgically remediable cause of heart failure, consideration of heart transplant, terminal cancer, participation in other clinical trials	Intervention $n = 100$: a clinical review was conducted within 2 weeks of discharge; individual and group education sessions were led by a study nurse and cardiologist post-discharge; a patient diary was kept; 6-weekly follow up by the GP and cardiac clinic continued for 12 months; a detailed letter was faxed to the GP on the same day as the cardiac clinic visit, with telephone communication to the GP if changes were needed to the management plan; the GP intervened as needed, the cardiac team were readily accessible to the GP, the study team were accessible during work hours for patients and GPs Control $n = 97$; usual care from GP

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Table 1. (*continued*)

Study, location, references	Study design and aim	Participants and setting	Intervention (and control)
COPD Chronic Disease Management Program, New Zealand; Rea *et al.* (2004)	Cluster randomised controlled trial Aim: to compare the effect of a chronic disease management program with conventional care on hospital admissions and quality of life, for patients with moderate to severe COPD	51 general practices (116 GPs) and 135 patients with COPD	Intervention $n = 83$: a respiratory physician and a nurse specialist assessed the patient; the GP and the practice nurse planned care with the patient; the nurse specialist and practice nurse trained the patient, who saw the practice nurse and GP regularly. The nurse specialist was linked to specialist and secondary care, and visited patients at least once. The nurse specialist and GP were notified if the patient was hospitalised Control $n = 52$: patients did not have a care plan and were not seen by the respiratory physician during assessment and did not have access to the nurse specialist. GPs had access to COPD management guidelines and to a pulmonary rehabilitation program
Bristol GPwSI dermatology service, UK; Salisbury *et al.* (2005), Coast *et al.* (2005)	Randomised controlled trial Aim: to assess the effectiveness, accessibility and acceptability of a GPwSI for skin problems *v.* hospital dermatology clinic, including cost effectiveness and consequences	556 patients referred to a hospital dermatology outpatient service	Intervention $n = 354$: GPwSIs and a specialist nurse were supported by a consultant dermatologist for two sessions per month from a suburban health centre Control $n = 202$: hospital-based outpatient service Patients were assessed for suitability for the GPwSI service by a consultant or GPwSI
Managing Complex Primary Health Care a chronic care management program, New Zealand; Sheridan *et al.* (2009)	Pre-post intervention (mixed methods) Aim: to evaluate a collaborative model integrating secondary care support into general practice	33 frequent adult medical admission hospital patients and general practice patients with complex conditions and high unmet health or social needs likely to become frequent adult medical admission patients. Specialist physicians and nurses (focus group). Pharmacist and acute care nurse (focus group). GPs and practice nurses (focus groups). 10 patients (interview)	The model involved nurse home visiting, the development of wellness plan, a record review, an interprofessional case conference and assertive follow up

Table 2. Assessment of quality and risk of bias (Cochrane risk of bias tool; Higgins and Green 2011)
GPwSI, general practitioner (GP) with a special interest; COPD, chronic obstructive pulmonary disease; N/A, not applicable

Study	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias; patient-reported outcomes)	Blinding of outcome assessment (detection bias)	Incomplete outcome data addressed (attrition bias; short-term outcomes: 2–6 weeks)	Incomplete outcome data addressed (attrition bias; longer-term outcomes: >6 weeks)	Selective reporting (reporting bias)
Diabetes studies								
Brisbane South Complex diabetes service	High risk	High risk	High risk	N/A	High risk	N/A	Low risk	Low risk
Leuven Diabetes Project	Low risk	Low risk	Moderate risk	N/A	Moderate risk	N/A	High risk	High risk
Diabetes shared medical appointment system	High risk	High risk	High risk	N/A	High risk	N/A	Moderate risk	Low risk
GPwSI-led specialist diabetes clinics	High risk	High risk	High risk	Low risk	Low risk	N/A	Low risk	Low risk
North Dublin Shared Care Diabetes Model	Low risk	Moderate risk	Moderate risk	High risk	Moderate risk	N/A	High risk	Low risk
Rural Aboriginal Diabetes Service	High risk	High risk	High risk	High risk	High risk	N/A	Low risk	Low risk
Other conditions								
Auckland Heart Failure Management Study	Low risk	Low risk	Moderate risk	Low risk	Low risk	N/A	Moderate risk	Low risk
COPD Chronic Disease Management Program	Low risk	Low risk	Low risk	N/A	Low risk	N/A	Low risk	Moderate risk
Bristol GPwSI dermatology service	Low risk	Low risk	Low risk	Moderate risk	Moderate risk	N/A	Low risk	Low risk
Managing Complex Primary Health Care	High risk	High risk	High risk	N/A	High risk	N/A	Low risk	Low risk

Table 3. Clinical outcomes of studies of integrated primary-secondary care for managing chronic/complex chronic disease

HbA1c, glycated haemoglobin; I, intervention group; C, control group; NS, no significant difference between intervention and control groups; SBP, systolic blood pressure; DBP, diastolic blood pressure; LDL-C, low-density lipoprotein – cholesterol; HDL-C, high-density lipoprotein – cholesterol; B, baseline; LV, last visit; CI, confidence interval; COPD, chronic obstructive pulmonary disease; FEV_1, forced expiratory volume in 1 s; ACEI, angiotensin-converting enzyme inhibitor; ARBs, angiotensin receptor blockers

References	Condition/length of follow up	Outcome measures	Results[A]
Diabetes interventions			
Jackson *et al*. (2010), Askew *et al*. (2010)	12 months	HbA1c% (s.d.) baseline to 12 months	*I = 9.0% (2.0) to 7.6% (1.7) (P = 0.0001)*; C = 8.3% (1.9) to 8.1% (1.8) (*P* = 0.23) *HbA1c change: significantly lower in intervention group (I) at follow up after adjusting for differences in HbA1c at enrolment (P = 0.001)*
Goderis *et al*. (2010); Borgermans *et al*. (2009)	18 months	HbA1c	NS
		SBP	NS
		DBP	NS
		LDL-C	NS
		HDL-C	NS
		Total cholesterol	NS
		Body mass index	NS
		Smoking status	NS
		Physical exercise (% undertaking)	*I = +21%; C = +12% (P < 0.001)* NS
		Medication use	*I = +8%; C = +1% (P = 0.001)*
		Statins	NS
		Anti-platelet therapy	NS
		Drug therapy intensification (initiation of insulin; blood pressure-lowering drugs, initiation of statins)	Significant change at follow up was observed for all three medication-related outcomes and for drug therapy intensification for patients 'not in good control' (C and I) at baseline (all *P* < 0.001), but there was no difference between groups in any parameter
Kirsh *et al*. (2007)	HbA1c: 10.8 ± 3.6 months[B] SBP: 11.5 ± 3.7 months LDL-C: 9.5 ± 4.5 months	HbA1c (mean change; %)	*I = –1.4; C = 0.30 (P = 0.002)*
		SBP reduction (mmHg)	*I = –14.83; C = –2.54 (P = 0.04)*
		LDL-C (mg dL^{-1})	I = 16.0; C = 5.37 (*P* = 0.29)
		Proportions meeting targets:	
		HbA1c	I = 35.5%; C = 45.2% (*P* = 0.153)
		SBP	*I = 26.5%; C = 17.6% (P = 0.031)*
		LDL-C	I = 80.8%; C = 65.4% *P* = 0.057)
Smith *et al*. (2004)	18 months	HbA1c	NS
		Total cholesterol	NS
		SBP	NS
		DBP	NS
		Body mass index	NS
		Diabetes wellbeing score	*I = 50.92; C = 47.59 (P = 0.008)*
Simmons (2003)	24 months	Weight	NS
		HbA1c % (s.d.)	*B = 10.4 (2.2); LV = 7.9 (1.9) (P < 0.001)*
		SBP (mmHg)	*B = 138 (20); LV = 127 (18) (P = 0.003)*
		DBP (mmHg)	*B = 78(11); LV = 73 (12) (P = 0.037)*
		Total cholesterol (mM; s.d.)	*B = 6.0 (1.8); LV = 5.0 (1.7) (P = 0.001)*
		Frequency of finger prick testing (%)	*B = 53; LV = 90 (P = 0.003)*
		Insulin use (%)	*B = 43.3; LV = 70.0 (P = 0.067)*
		Metformin use	NS
		Sulfonylurea use	NS

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Table 3. (*continued*)

References	Condition/length of follow up	Outcome measures	Results[A]
		Blood pressure (median no. medications)	*B = 1 (0–4); LV = 2 (0–4) (P < 0.001)*
		No. of antihypertensive agents	NS
		Percentage use of ACEI/ARBs	NS
		Aspirin	NS
		Smoking	NS
		Total cholesterol (mM; s.d.)	*B = 6.0 (1.8); LV = 5.0 (1.7) (P = 0.001)*
		Triglycerides (mM)	NS
		Use of statin	NS
		Use of fibrate	NS
		Eye check	NS
Interventions for other conditions			
Doughty *et al.* (2002), Pearl *et al.* (2003)	Heart failure, 12 months	Time to death or readmission	NS
		Minnesota Living with Heart Failure scale:	
		Physical functioning	*I = –5.8; C = –11.1 (P = 0.015)*
		Emotional functioning	NS
Rea *et al.* (2004)	COPD, 12 months	Spirometry FEV_1: % predicted	*I = 1.17 to 1.20; C = 1.14 to 1.09 (P < 0.001)*
		Shuttle walk test	*I = 51.8 to 53.9; C = 50.0 to 45.6 (P < 0.001)*
		Short-Form 36-item Health Survey	NS
		Chronic Respiratory Questionnaire (dyspnoea, fatigue, emotional function and mastery)	NS *Fatigue sub-scale I = 15.3 to 17.7; C = 15.3 to 15.7 (P = 0.010); Mastery subscale I = 18.9 to 21.4; C = 20.1 to 20.7 (P = 0.007)*; Others (n = 2) NS
		Smoking status	NS
Salisbury *et al.* (2005), Coast *et al.* (2005)	Dermatology, 9 months	Dermatology quality of life index:	(Ratio of geometric means):
		6 weeks	1.13 (95% CI = 0.96–1.13; P = 0.14)
		9 months	0.99 (95% CI = 0.85–1.15; P = 0.88)

[A]Statistically significant results are in italics.
[B]Time from first Shared Medical Appointment between patient and multidisciplinary team.

Nocon *et al.* 2004) and clearly defined roles (Doughty *et al.* 2002; Nocon *et al.* 2004; Sheridan *et al.* 2009). Barriers to team functionality included GPs being too busy for direct involvement in comprehensive patient care, inadequate access to other key personnel and lack of role clarity (Simmons 2003; Smith *et al.* 2004; Sheridan *et al.* 2009). Nocon *et al.* (2004) reported clinicians' concerns that, without role clarity for referring GPs and specialist clinics, duplications and omissions may occur in managing co-morbidities.

Element 2: communication and information exchange

Effective integration involves willingness to share information, and supportive managerial and administrative staff (Rea *et al.* 2004; Smith *et al.* 2004). A high level of GP trust in specialists was regarded as important, as was improved communication between GPs and hospital specialists (Coast *et al.* 2005; Jackson *et al.* 2010) and shared follow up supported by electronic reminder systems (Doughty *et al.* 2002; Kirsh *et al.* 2007). Shared governance that enhanced system capacity for effective communication and collaboration (Simmons 2003) and regular interdisciplinary team meetings that enabled information exchange (Borgermans *et al.* 2009; Sheridan *et al.* 2009) were also seen as important. Successful communication channels included case conferences (Sheridan *et al.* 2009). Co-located GP and specialist clinics facilitated effective communication and information exchange between GPs and specialists (Simmons 2003), as well as ongoing access to specialists and shared follow up (Nocon *et al.* 2004).

Element 3: use of shared care guidelines or pathways

Pragmatic, locally agreed care protocols were a key component of most of the integrated care models (Doughty *et al.* 2002; Simmons 2003; Nocon *et al.* 2004; Rea *et al.* 2004; Smith *et al.* 2004; Borgermans *et al.* 2009; Goderis *et al.* 2010; Jackson *et al.* 2010). The protocols included guidance for post-discharge care and review (Smith *et al.* 2004), shared care planning (Jackson *et al.* 2010), patient goal-setting and self-management (Rea *et al.* 2004) and structured electronic record and recall systems (Simmons 2003).

Element 4: training and education

Initial and continuing education, including postgraduate training, is essential for primary care clinicians to facilitate

Table 4. Process outcomes of studies of integrated primary–secondary care for managing chronic/complex chronic disease

NS, no significant difference between intervention and control groups; I, intervention group; C, control group; CI, confidence interval; GP, general practitioner; HbA1c, glycated haemoglobin; ACE, angiotensin-converting enzyme; COPD, chronic obstructive pulmonary disease; 2*P*, two-tailed probability

References	Condition/length of follow up	Outcome measures	Results
Diabetes interventions			
Jackson *et al*. (2010), Askew *et al*. (2010)	Diabetes, 12 months	Non-attendance rate	I = 10%; C = 24%
Nocon *et al*. (2004)	Diabetes, 3.5 years	New and follow-up patients attending hospital	NS
		New and follow-up patients attending specialist primary care clinic	NS
		Non-attendance rate	Clinics = 25% (range = 12–37%) *v.* Hospital = 19%
		Service use	Mean monthly hospital attendance fell from 478.5 in year 0 to 361.6 in year 2 ($P < 0.0001$).
		Patient satisfaction	Combined hospital and clinic attendance increased from year 0 to year 2, 35% (169.6, 95% CI = 109.5–229.6) Patient-identified benefits (I): comprised more frequent and more convenient appointments, shorter waiting times, clinics nearer to home, easier parking and a more friendly and personal service Patient-identified barriers (I/C): included a preference for hospital, unknown quality of care, lack of transport, inconvenient locations for patients, and lack of confidence in skills of the clinic staff
		Provider satisfaction	(I) Providers identified the importance of planning, protocols, role clarity, multidisciplinary teamwork, enhanced communication and adequate funding
Smith *et al*. (2004)	Diabetes, 18 months	Number of general practice diabetes registers	Increased by 120%
		Proportion very satisfied with treatment	I = 56%; C = 27% ($P < 0.01$)
		Information exchange between sectors	A reduction in information stored only in one sector (all measures $\leq$ to $P = 0.005$).
		Patients attending appropriate allied health	NS
		Patients on lipid-lowering agents; aspirin or warfarin	NS
		Improved GP recording at 6 months:	
		Blood pressure	I = 78%; C = 61% ($P = 0.046$)
		Smoking status	I = 82%; C = 66% ($P = 0.003$)
		Fundoscopy check	I = 60%; C = 39% ($P = 0.024$)
		Microalbuminuria test	I = 45%; C = 11% ($P = 0.004$)
		Serum creatinine	I = 46%; C = 9% ($P = 0.001$)
		Process indicators from baseline to 6 months:	
		Number attending annual reviews in specialist centre	I increased from 65% to 85% ($P < 0.0001$)
		Proportion of patients defaulting from care (patient self-report)	I = 8% decrease; C = 7% increase ($P = 0.008$)
Other conditions			
Doughty *et al*. (2002), Pearl *et al*. (2003)	Heart failure, 12 months	Number of GP consultations	NS
		All-cause hospital readmissions	NS
		All-cause hospital bed days:	
		First re-admissions	NS
		Subsequent re-admission rate (annual)	I = 1.37; C = 1.84 ($2P = 0.015$)

(*continued next page*)

Table 4. (*continued*)

References	Condition/length of follow up	Outcome measures	Results
		Bed days for subsequent re-admissions (annual)	I = 526; C = 726 (2*P* = 0.0001)
		Heart failure admissions	
		First readmission (*n*)	I = 21; C = 23 (NS)
		Bed days for first re-admission	I = 219; C = 195 (NS)
		Subsequent re-admissions (*n*)	I = 15; C = 42 (2*P* = 0.036)
		Subsequent bed days	I = 139; C = 366 (2*P* = 0.0001)
		Appropriate use of medications	NS in use or dose of frusemide, digoxin, ACE inhibitors
		Provider satisfaction	91% GPs highly satisfied with shared care
		Patient satisfaction	88% of GPs felt intervention helped patient 89% patients highly satisfied with shared care
Rea *et al*. (2004)	COPD, 12 months	Prescribing patterns	NS
		Hospital admissions	NS
		Emergency presentations	NS
		Mean respiratory specialist bed days per annum	I = 2.8 to 1.1; C = 3.5 to 4.0 (*P* = 0.030)
Salisbury *et al*. (2005), Coast *et al*. (2005)	Dermatology, 9 months	Patient perception of access to services	I = 76.1; C = 60.5: adjusted difference 14.9% (95% CI = 11–19; *P* < 0.001)
		Patient consultation satisfaction	I = 71.05; C = 65.9: adjusted difference 4.1 (95% CI = 0.9–7.2; *P* = 0.01)
		Mean waiting time (days) to first appointment	I = 72; C = 113: adjusted difference 40 (95% CI = 35–46; *P* < 0.001)
		Proportion of failed appointments	I = 6%; C = 11% (*P* = 0.04)
Sheridan *et al*. (2009)	Complex cases, 8 months	Hospital admissions (per annum rate)	Pre: 149, Post: 93 at 4 months, projected to 1 year
		Hospital bed days (per annum rate)	Pre: 598, Post: 459 at 4 months, projected to 1 year
		Patient access	Enhanced patient-practice nurse relationship, access to help, especially social services; social gains justified the cost
		Provider satisfaction	Clinicians better informed through case conferences Faster GP access to secondary services; better information exchange between hospital and primary care, and safe patient transitions

integrated care for patients with chronic/complex chronic disease (Nocon *et al*. 2004; Smith *et al*. 2004; Kirsh *et al*. 2007; Borgermans *et al*. 2009; Sheridan *et al*. 2009; Jackson *et al*. 2010). Patient education was also identified as a core element of several care models (Doughty *et al*. 2002; Pearl *et al*. 2003; Simmons 2003; Rea *et al*. 2004; Kirsh *et al*. 2007; Borgermans *et al*. 2009; Jackson *et al*. 2010).

Element 5: access and acceptability

Most studies had improved access of care as an objective, with considerable inter-study variation in how these were achieved and what the effects were. Patient satisfaction with models of integrated care was generally high (Nocon *et al*. 2004). They felt their priorities and preferences were respected (Sheridan *et al*. 2009); they valued the geographic convenience, easier parking and better facilities, and the 'one-stop shop' that improved communication and gave them better access to, and continuity of, care in a friendlier, more personal service (Doughty *et al*. 2002; Coast *et al*. 2005; Salisbury *et al*. 2005). Patients also appreciated the reduced waiting time to their first appointment, and were satisfied with the consultation, including its duration (Coast *et al*. 2005; Salisbury *et al*. 2005). Integrated community clinics also offered them more frequent and convenient appointments with a larger pool of well-trained GPs (Coast *et al*. 2005). On the negative side, patients' concerns included a lack of confidence in the skills of GPs with a special interest (GPwSIs), perceptions that the specialist was less accessible under integrated care, and some were critical of the quality of care provided (Nocon *et al*. 2004).

GPs expressed satisfaction with clinics staffed by GPs (Smith *et al*. 2004), but expressed concerns about inadequate information regarding the purpose and function of the clinic, as well as longer waiting times and suboptimal communication with specialists (Nocon *et al*. 2004). Referring GPs were also concerned that unnecessary referrals could potentially de-skill them, and were

Table 5. Economic outcomes of studies of integrated primary–secondary care for managing chronic/complex chronic disease
I, intervention group; C, control group; GPwSI, general practitioner (GP) with a special interest

References	Condition	Outcome measures	Results
Diabetes interventions			
Jackson *et al*. (2010), Askew *et al*. (2010)	Diabetes	Total mean cost per patient attendance	Costs per patient per visit: I = A$150; C = A$774.
			Frequency of doctor visits: I = 4.3; C = 1.8
		Frequency of visits	Frequency of diabetes educator visits: I = 2.4; C = 0.3
Goderis *et al*. (2010), Borgermans *et al*. (2009)	Diabetes	Annual cost per patient	I = $US261; C = $US210
Nocon *et al*. (2004)	Diabetes	Cost per patient attendance	No difference between hospital and clinic costs
Interventions for other conditions			
Coast *et al*. (2005)	Dermatology	Cost to National Health Service (NHS) per consultation Cost to patient and companions Cost of lost production Cost-effectiveness Cost-consequences	I = £208; C = £118
			Higher-cost of GPwSI service balanced by improved access and broadly similar health outcomes
			Cost of incremental gain: 1 point in Dermatology index (I over C) = £540: 10 point gain in accessibility score (I over C) = £65

Table 6. Design elements that underpin effective models of integrated primary–secondary care

Study	Interdisciplinary teamwork	Communication/ information exchange	Shared care guidelines or pathways	Training/ education	Access and acceptability	A viable funding model
Brisbane South Complex Diabetes Service	●	●	●	●		●
The Leuven Diabetes Project	●	●	●	●		●
Diabetes shared medical appointment system	●	●	●	●		
GPwSI-led specialist diabetes clinics	●		●	●	●	●
North Dublin Diabetes Shared Care Model	●	●	●	●	●	
Rural Diabetes Integrated Care Clinic	●	●	●	●		●
Auckland Heart Failure Management study	●	●	●	●	●	
COPD chronic disease management program	●	●	●	●		
Bristol GPwSI dermatology service		●			●	●
Managing Complex Primary Health Care	●	●	●		●	●
No. of studies reporting/discussing each element	9	9	9	8	5	6

fearful of having no back-up and having their patients 'poached' (Nocon *et al*. 2004).

Element 6: a viable funding model

Viable funding models are essential for continuation of a program after the pilot work has been completed. Concerns around funding related to the cost of the clinic model itself, the impact of the model on existing services, and the uncertainty of future funding. One community model delivered diabetes care at half the cost of usual hospital-based outpatient care (Jackson *et al*. 2010). In another study, the cost of an integrated model was reported as equivalent to traditional alternatives (Doughty *et al*. 2002), while others found that additional costs were balanced out by social gains (Borgermans *et al*. 2009). Two studies reported potentially inadequate funding for the model's specialist resources (Sheridan *et al*. 2009), and about sustainability of the GPwSI service without additional funding (Smith *et al*. 2004). Studies of costlier integrated care models attributed this to more frequent follow-up appointments (Salisbury *et al*. 2005), the higher cost of community-based pathology services (Coast *et al*. 2005), the time required for chart audits and patient home visits (Sheridan *et al*. 2009) or the more intense care regimen of the community model (Simmons 2003).

Discussion

This review has examined the operations and effectiveness of integrated models of care at the interface of primary and secondary care – a defined subset within the many variants of primary–secondary care models. It details the limited evidence

base informing the design and implementation of this particular model of care. The defined focus on models of care that involved active negotiation of the scope of care means that the number of studies identified is smaller than the other systematic reviews previously conducted.

Our findings confirm the modest impact on clinical outcomes as well as substantial impact on process outcomes of integrated care models, and the mixed costs data pertaining to them, found with other reviews of primary–secondary care integration. Importantly, no study was found that reported worse outcomes of any integrated primary–secondary care model compared with usual care, although publication bias may be a possible explanation. It appears that the modest increased costs of such interventions will have substantial impact on service utilisation, and trying to incorporate into policy and practice may be worthwhile.

Heterogeneity in outcome measurements means that no uniform conclusions could be made about ideal model types, apart from generating principles to guide model development.

We have shown that, while models can look very different on the ground, there are six operational principles underlying them. Our list of essential characteristics overlaps substantially with the characteristics identified by Ouwens *et al*. (2005). The two lists share three features (Multidisciplinary patient care team, Multidisciplinary clinical pathway, and Feedback, reminders and education for professionals). Ouwens *et al*. (2005) also identify one patient-focussed feature (self-management support and patient education), which does not feature on our list due to this research's focus on the interface between specialist and primary care health professionals. Our review identified two new features – a need for a secure funding model and an emphasis on ease of access for patients and subsequent acceptability by patients and general practitioners.

Our review highlights the need for a secure funding model. While this is self-evident, attention to this critical feature should be paid early in the course of trialling new methods of interdisciplinary teamwork to maximise the possibility of seamless transition from pilot phase to routine practice. Economic evaluation of clinical models that demonstrate benefits in policy and practice is critical to facilitating the adoption of new clinical models by health administrators and policymakers, and should be built in to the evaluation plan at the outset.

A focus on improving the accessibility of the service to patients by placing it in the community improved efficiency in time and costs, and satisfaction in both patients and general practitioners. It appears that a patient-focussed approach to service delivery, compared with a utilitarian approach of maximising efficiency by having the services located in hospitals where the specialists are, can reap qualitative benefits and may improve attendance rates and treatment compliance.

Limitations

The review has limitations. The generalisability of our findings to care settings with significant social care elements is limited by our selection criteria. By excluding studies in paediatrics, mental health and oncology from our searches *a priori*, we may have excluded studies which in fact did utilise the type of GP-specialist care we wished to examine. Our paper relied on studies that were conducted at the level of health service delivery and reported outcomes directly attributable to the model of care, rather than a broader health system perspective. The review included only English language articles published between January 2000 and July 2012, and it is likely that relevant unpublished reports as well as articles published in other languages exist that address our topic.

Future research

In a society in which chronic/complex chronic disease is so prevalent, effective and sustainable integrated care models have become a priority, and more research is urgently needed to identify those models that work best. In particular, further intervention studies are needed to measure the effects of primary–secondary care models, and importantly their impact on outcomes including quality of life, user satisfaction and effective resource management.

Conclusion

Compared with usual care, integrated primary–secondary care has limited effect on clinical outcomes, but can significantly improve service delivery measures at a modestly increased cost. Future trials of integrated models of care could consider incorporating the design elements identified in this review, which may enhance their effectiveness.

Competing interests

The authors declare they have no competing interests.

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Appendix 1. Study search terms

GPwSI, general practitioner (GP) with a special interest; GPSI, GP with a special interest

Key concepts	Search terms and synonyms	Equivalent MeSH terms and synonyms
Integrated models of care	Model	Nil
	Practice model	Nil
	Program*	Wellness programs, Managed care programs, Program development, Program descriptions, Program evaluation
	Case manage*	Case management
	Service*	
	Continuity	Continuity of patient care
	Co-ord* OR Coord*	Coordination, administrative
	Integrat*	Delivery of health care, integrated
	Holistic	Holistic health
	Shared care	Nil
	Collab*	Cooperative behaviour
	Partner*	Public–private sector partnerships
	Multidisciplinary	Multidisciplinary communication
	Multidisciplinary care	Nil
Primary and secondary care	Primary and secondary	Nil
	Comprehensive	
	Specialist*	Nil
	Speciality care	Nil
	Interface	
	Transition*	
	Intersectoral	Nil
	Cross-sectoral	Nil
	alliance	
	Consumer	Consumer participation, patient participation
	Primary care	Primary health care
	Primary practi*	Nil
	General practi*	General practice
	GP	General practitioners
	Community care	Community health or health care
	Family practi*	Family practice
	Family physician	Physicians, family
	GPwSI OR GPSI	
	'General practitioner*' AND 'With special interest*'	
Chronic/complex chronic disease	'Complex chronic'	Chronic disease
	Chronic condition	Nil
	Chronic disease	Chronic disease
	Chronic illness	Chronic disease
	Multiple health problems	Nil
	Multimorbidity	Nil
	Comorbidity	Comorbidity
	Polypathology	Nil
Outcome*		

Appendix 2. Full description of risk of bias in studies

GPwSI, general practitioner with a special interest; COPD, chronic obstructive pulmonary disease; N/A, not applicable; RCT, randomised controlled trial

	Brisbane South Complex diabetes service (Askew *et al.* 2010; Jackson *et al.* 2010)	Leuven Diabetes Project (Borgermans *et al.* 2009; Goderis *et al.* 2010)	Diabetes shared medical appointment system (Kirsh *et al.* 2007)	GPwSI in Diabetes (Nocon *et al.* 2004)	North Dublin Shared Care Diabetes Model (Smith *et al.* 2004)	Rural Aboriginal Diabetes Service (Simmons 2003)	Auckland Heart Failure Management Study (Doughty *et al.* 2002; Pearl *et al.* 2003)	COPD (NZ) (Rea *et al.* 2004)	Bristol GPwSI study (Salisbury *et al.* 2005; Coast *et al.* 2005)	Chronic care management (NZ) (Sheridan *et al.* 2009)
Random sequence generation (selection bias)	High risk (separate non-random control)	Low risk (computer-generated randomisation)	High risk (separate non-random control)	High risk (non-randomly selected groups)	Low risk (random number table allocation by independent researcher)	High risk (before/after study)	Low risk (computer-generated random numbers)	Low risk (Randomisation with computer-generated random numbers)	Low risk (computer-generated randomisation schedule)	High risk (non-randomised Pre-post study)
Allocation concealment (selection bias)	High risk (separate non-random control)	Low risk (computer-generated randomisation	High risk (separate non-random control)	High risk (nonrandomly selected groups)	Moderate risk (Treating GPs not blinded to allocation, patients blinding not reported)	High risk (before/after study)	Low risk (computer-generated random numbers)	Low risk (Randomisation with computer-generated random numbers, cluster RCT)	Low risk (blind patient allocation)	High risk (non-randomised Pre-post study)
Blinding of participants and personnel (performance bias)	High risk (separate non-random control)	Moderate risk (GPs not blinded to allocation, patients were blinded)	High risk (separate non-random control)	High risk (nonrandomly selected groups)	Moderate risk (GPs not blinded, cluster randomisation reduced risk of patient contamination)	High risk (before/after study)	Moderate risk (GPs informed of participation in study, patients blind to allocation)	Low risk (all GPs delivered COPD guidelines, intervention GPs only aware of allocation)	Low risk (blind patient allocation)	High risk (non-randomised Pre-post study)
Blinding of outcome assessment (detection bias) (patient-reported outcomes)	Patient-reported outcomes not done	Patient-reported outcomes not done	N/A	Low risk (data reported were hospital service utilisation only)	High risk (identity and blinding of staff collecting patient data not defined)	High risk (before/after study)	Low risk (patient blinded to allocation)	N/A	Medium risk (single blind assessment)	N/A
Blinding of outcome assessment (detection bias)	High risk (separate non-random control)	Moderate risk (data collected by patient's GP; analysis done by researchers blinded to individual patient allocation)	High risk (not stated whether the analyst was blinded to intervention)	Low risk (data reported were hospital service utilisation only)	Moderate risk (Identity of staff collecting process data not defined but data extracted from written records, biomedical tests done by one individual)	High risk (before/after study)	Low risk (data collected by trained observers. Blinding to allocation probably done)	Low risk (all assessment done post trial)	Medium risk (RCT design, but analysis appears to be done in part by clinician investigators)	High risk (non-randomised Pre-post study)
Incomplete outcome data addressed (attrition bias) (Short-term outcomes (2–6 weeks))	N/A	Low risk (data analysed using intention-to-treat principle)	N/A	Low risk (data reported were hospital service utilisation only)	N/A	Low risk (before data recorded from records and clinic attendance a prerequisite of participation)	N/A	N/A	N/A	N/A

(*continued next page*)

Appendix 2. (*continued*)

	Brisbane South Complex diabetes service (Askew *et al.* 2010; Jackson *et al.* 2010)	Leuven Diabetes Project (Borgermans *et al.* 2009; Goderis *et al.* 2010)	Diabetes shared medical appointment system (Kirsh *et al.* 2007)	GPwSI in Diabetes (Nocon *et al.* 2004)	North Dublin Shared Care Diabetes Model (Smith *et al.* 2004)	Rural Aboriginal Diabetes Service (Simmons 2003)	Auckland Heart Failure Management Study (Doughty *et al.* 2002; Pearl *et al.* 2003)	COPD (NZ) (Rea *et al.* 2004)	Bristol GPwSI study (Salisbury *et al.* 2005; Coast *et al.* 2005)	Chronic care management (NZ) (Sheridan *et al.* 2009)
Incomplete outcome data addressed (attrition bias) (Longer-term outcomes (>6 weeks))	Low risk (incomplete data addressed)	High risk (case wise deletion was used for each analysis)	Moderate risk (No discussion of how missing data was managed. Historical data from non-matched controls extracted from clinical notes, so risk of missing data is low)	Low risk (data reported were hospital service utilisation only)	High risk (incomplete data management not addressed)	Low risk (before data recorded from records and clinic attendance a prerequisite of participation)	Moderate risk (management of incomplete data not described)	Low risk (intention-to-treat analysis)	Low risk (incomplete data assumed to be the last recorded data entry)	Low risk (hospital records of all subjects examined)
Selective reporting (reporting bias)	Low risk (data from all participants reported)	High risk (case-wise deletion was used for each analysis)	Low risk (data from all participants reported)	Low risk (data reported were hospital service utilisation only)	Low risk (all parameters described in methods were reported)	Low risk (before data recorded from records and clinic attendance a prerequisite of participation)	Low risk (All parameters assessed are reported)	Medium risk (missing data management not discussed; patient dropout discussed)	Low risk (all parameters reported in results)	Low risk (hospital records of all subjects examined)