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The evidence for integrated care

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Authored by:
Grail Dorling
Tim Fountaine
Sorcha McKenna
Brindan Suresh

Summary

In this paper, we review the evidence for integrated-care interventions from published clinical trials. We have conducted a systematic search for relevant studies published in the last ten years, identifying 34 systematic reviews (which collate the findings from many hundreds of individual studies) and 9 additional studies. We focused on studies measuring two end points in particular: hospital admissions and, for interventions aimed at people with diabetes, changes in HbA1c.[1] Assessing all the available evidence, we found that integrated-care programs were associated with a 19 percent reduction in hospital-admission rates, compared with usual care. For programs aimed at people with diabetes, we found that integrated care was associated with a mean 0.5 percentage point reduction in HbA1c compared with usual care. Because integrated care is a multicomponent intervention, we also looked at the elements commonly found in successful programs. We found that four elements appear to be particularly important: patient education and empowerment, care coordination, multidisciplinary teams, and individual care plans.

Introduction

Against a backdrop of an aging population, a rising burden of chronic disease and complex multimorbidity, higher expectations for quality of care, and a tight financial climate, there is a common need to deliver better care in a more cost-effective way. Integrated care has emerged as one potential solution to this problem. It has been tried in different forms in many different health systems around the world. However, there is no precise shared definition of integrated care, and even the term itself is contentious, with many systems using alternative language such as *coordinated care, patient-centered collaborative care, or disease management* to describe essentially similar delivery models.[2] Alongside this, and perhaps partly a consequence of this lack of clarity, there is a widely held perception that the evidence for integrated care is nonexistent, weak, or too mixed to interpret in a meaningful way to support service design and planning.[3]

However, despite the lack of a precise definition, almost all integrated-care programs have a clear common purpose: to support individuals with chronic-care needs to live independently with coordinated care that empowers the patient and as a result reduces demand for hospital admissions. In addition, most programs share many common core elements. The differences among programs mainly reflect how the common approaches are tailored to different health-system contexts and cultures, workforce norms and practices, and of course, target-population profiles and case mix.

We recognize that there are clear challenges in interpreting the evidence for integrated care. As a health intervention, it does not easily lend itself to scientific evaluation and analysis. There is no single target population: integrated care may be aimed at a disease-defined patient group—for example, people with diabetes, congestive heart failure (CHF), or chronic obstructive pulmonary disease (COPD)—or people with complex chronic multimorbidity, or it can be aimed at demographically defined subpopulations, such as the frail elderly. There is no established generic (i.e., not disease-specific) primary outcome to measure. On top of this, integrated care is, by definition, not a single intervention that can be isolated from other

1 A measure of blood glucose levels (haemoglobin A1c).

2 John Øvretveit, Does Clinical Coordination Improve Quality and Save Money?, Health Foundation, June 2011, health.org.uk.

3 HSJ/Serco Commission on Hospital Care for Frail Older People, Main Report, November 2014, hsj.co.uk.

elements of practice. Integrated care can only be practiced in the "real world" by unblinded clinicians and patients, so the scientific validity of clinical trials is bound to be questioned. Finally, quality of implementation in integrated care is critical to its impact. Successful implementation requires not just changes in treatment, but also behavioral and cultural changes on the part of clinicians, patients, and organizations. As these aspects are almost impossible to observe or quantify scientifically, it is important to recognize that the academic studies that do exist constitute a largely undifferentiated mix of interventions representing the full spectrum of implementation quality.

We recognize and acknowledge these challenges in understanding and interpreting the evidence for integrated care. However, we firmly believe that these difficulties should not be used to justify a paralysis in decision making in an area where there is clearly an urgent and compelling need for action in the near term. Our review of the evidence is conducted in the spirit of an attempt to identify what can be learned from the existing evidence while recognizing that this evidence can probably never satisfy everyone.

Our aim has been to answer two questions:

1. What does the body of evidence tell us about the impact of integrated care on hospital utilization?

2. What does the evidence tell us about how to design a successful integrated-care program?

Method

We began by reviewing the policy literature on integrated care to create a comprehensive set of synonyms for integrated care to use as primary search terms. We used this as the basis for our search strategy, adding a set of terms for common chronic conditions (including *chronic condition, long-term condition, and multimorbidity*) and parameters for language (English only) and time (last ten years, 2003–2013). We tested this strategy in the PubMed bibliographic database. The number of papers found was so large as to be unmanageable, so we restricted the search to systematic reviews (i.e., papers collating the findings from multiple studies).

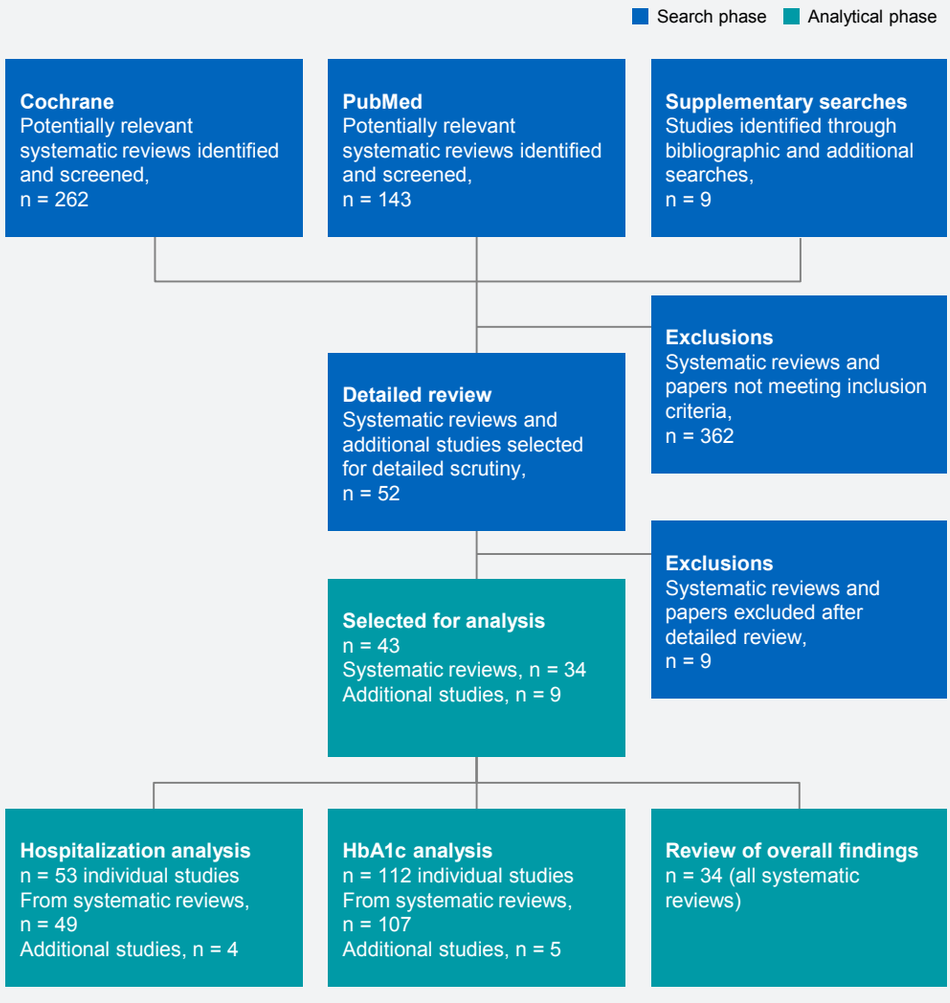
We conducted this search in the PubMed and Cochrane databases (Exhibit 1). These results were supplemented by papers identified through a search of the bibliographies of policy papers on integrated care, including papers published by the King's Fund, Nuffield Trust, and Health Foundation. We then conducted a separate literature search for additional relevant studies published since 2012, using the same search strategy as described but without the systematic-review requirement, to identify studies published too recently for inclusion in the recent systematic reviews. We reviewed relevant papers against the inclusion/exclusion criteria and added them to the data set where relevant (for full details, see Exhibit A in the appendix).

All potentially relevant papers were reviewed by two researchers against a predefined set of inclusion criteria:

- The review had identified at least one controlled trial.
- The review included a screening of trials to include them on the basis of the quality of the trial design.
- The review contained sufficient data from the included trials to support further analysis.
- The target population was people with a chronic condition or chronic multimorbidity.
- The studies included in the review were multicomponent interventions (or at least some of the studies included were multicomponent, and there was sufficient information provided to identify which) and included primary care (i.e., no hospital-only interventions) plus at least one element of integrated care, including personalized care planning, evidence-based protocols, care management, care coordination, and use of multidisciplinary teams.

Systematic literature search included search and analytical phases

Exhibit 1



From the 34 systematic reviews identified for inclusion (full details available in Exhibit A in the appendix) and the additional papers identified through supplementary searching, we identified a subset of 53 individual published studies that measured the change in hospital admissions for the intervention group versus a control group and provided sufficient information (for example, on the number of patients in each arm of the trial, and the baseline and end-point rates of hospitalization) for further analysis. We used the full texts of the individual studies to gather the data for this analysis in order to reduce transcription errors and ensure nonduplication (in case the same study was reported under different names in different systematic reviews). We used this data set for statistical analysis, calculating the relative risk and the variance for each study based on the basic statistics collected from the respective papers, and building fixed-effects and random-effects models to measure the aggregated effect size, confidence intervals, *p*-value, and measures of heterogeneity.

We followed the same process to identify a subset of individual studies investigating care for people with diabetes by measuring the change in HbA1c for the intervention group versus a control group. This led to the identification of 112 individual relevant studies (Exhibit C in the appendix).

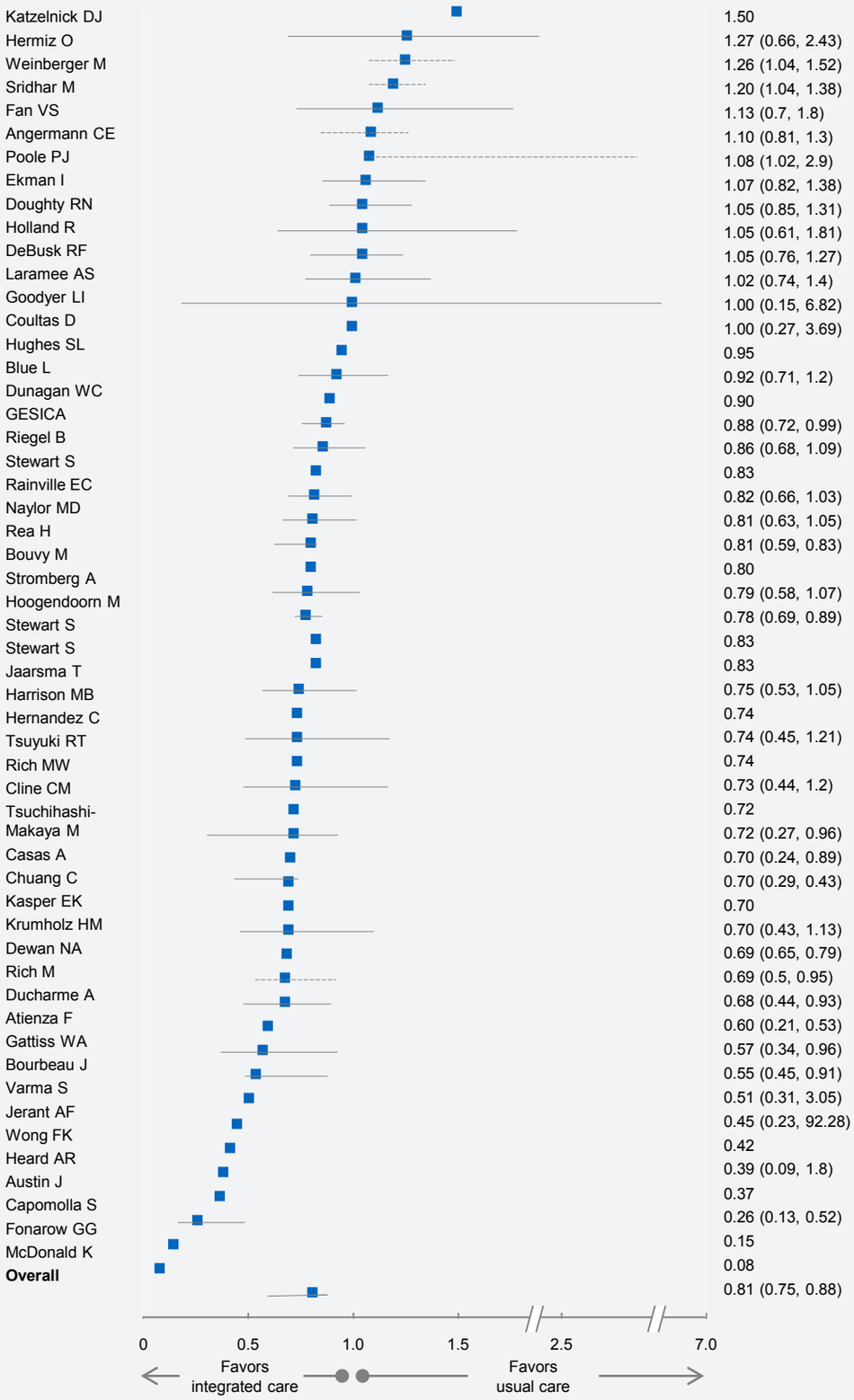
Findings

The evidence review yielded 53 individual controlled trials investigating the impact of integrated care on hospital admission rates with sufficient depth of data available to allow for meta-analysis. In aggregate, using a fixed effects model, these results show a statistically significant reduction in the probability of hospitalization for patients in integrated-care programs of 19 percent when compared with usual care (relative risk 0.8141, 95 percent confidence interval [0.7528, 0.8754], $p < 0.0001$), as shown in Exhibit 2.

Hospitalization risk is lower for integrated-care group than for controls

Exhibit 2

Relative risk and 95% confidence intervals



Source: See appendix for full details.

This analysis covers a wide range of different types of interventions meeting the inclusion criteria. It also covers patients with a wide range of different chronic conditions and levels of disease severity. As might be expected, considering that the duration of most studies was less than two years, we found more relevant studies for diseases with a high baseline risk of admission, such as chronic heart failure in the immediate term. Almost half of the studies identified were from the USA, with the rest from 13 other countries.[4]

Most published studies evaluating the impact of integrated care for people with diabetes use mean difference in HbA1c as the primary outcome measure. Only very rarely do they measure hospital admissions, although studies elsewhere have demonstrated the association of uncontrolled HbA1c (outside of the recommended range) and higher hospital admission rates with a range of outcome measures, including hospital admissions (from all causes), amputation, cataract extraction, microvascular end points, heart failure, myocardial infarction, stroke, and mortality (from all causes and diabetes related).[5]

We identified 112 individual trials that measured and reported the reduction in HbA1c achieved for integrated-care interventions compared with usual care The results show that, on average, integrated care delivers a 0.5-percentage-point reduction in HbA1c (Exhibit 3, with trial authors and estimates listed in Exhibit 4). While this reduction may appear small, it is clinically significant, given the gradient of the relationship between HbA1c and outcomes, with each 0.5 percent reduction in HbA1c associated with a 10.5 percent reduction in diabetes-related complications and mortality (all end points).[6] The published papers included insufficient data for creating a fixed-effects model based on these results.[7] Almost two thirds of the studies identified were from the USA, with the rest from 16 other countries.[8]

4 Including Argentina, Australia, Belgium, Canada, Hong Kong, Ireland, Italy, Japan, Netherlands, New Zealand, Spain and the United Kingdom.

5 L. Govan et al., "Achieved levels of HbA1c and likelihood of hospital admission in people with type 1 diabetes in the Scottish population," Diabetes Care, 4 (2011): 1992–97; Irene M. Stratton et al., "Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): Prospective observational study," BMJ, 321 (2000): 405–12; Diabetes Control and Complications Trial Research Group, "The effect of intensive treatment of diabetes on the development and progression of long- term complications in insulin-dependent diabetes mellitus," New England Journal of Medicine, 329 (14) (1993): 977–86.

6 Stratton et al., "Association of glycaemia with macrovascular and microvascular complications."

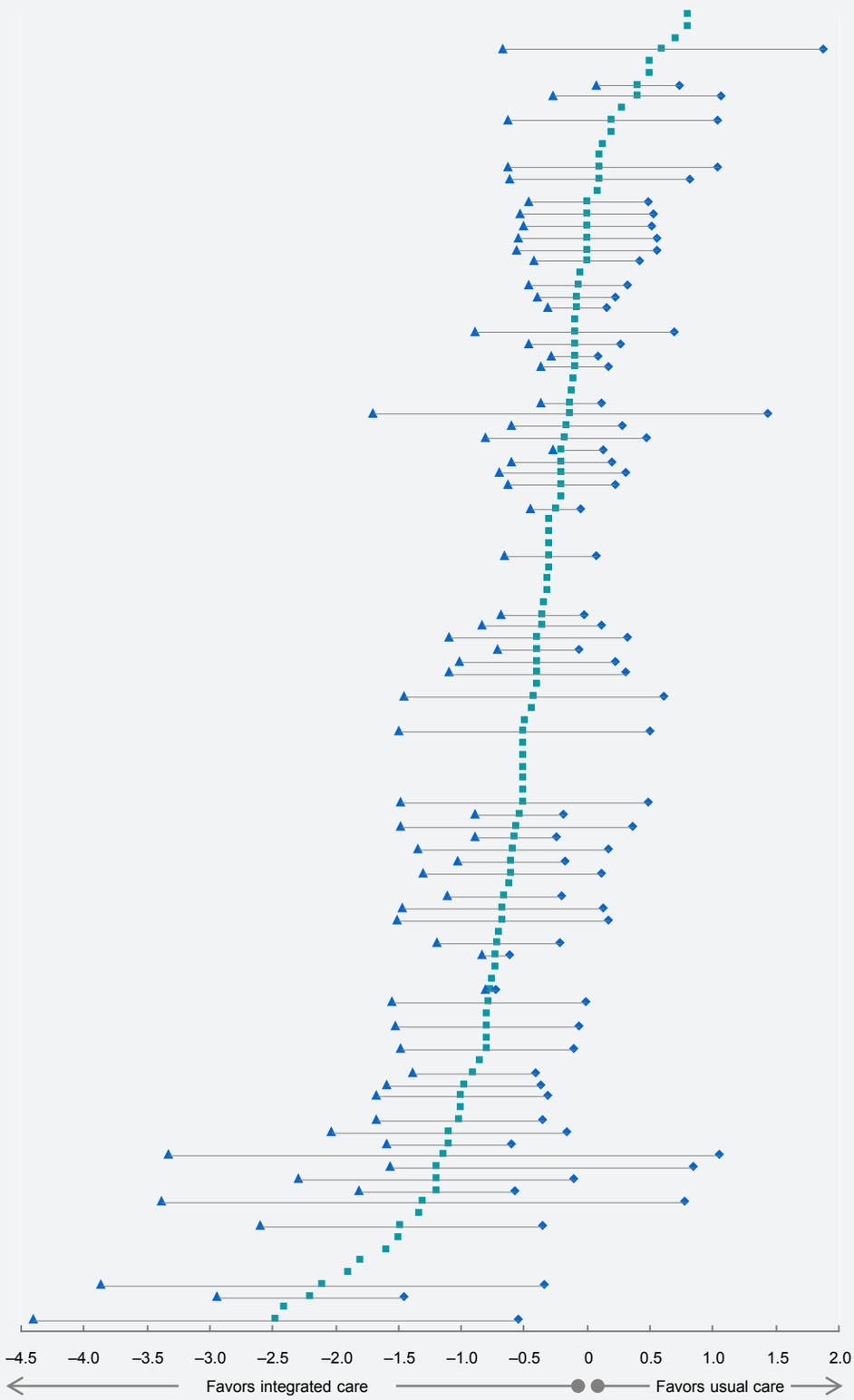
7 Papers reported the change (standardized mean difference) in HbA1c between intervention and control groups—and, in many cases, the confidence interval for the change—but did not routinely report the baseline and end-point HbA1c values for intervention and control groups.

8 Including Australia, Austria, Canada, China, Denmark, Finland, Germany, Hong Kong, Israel, Italy, Japan, Korea, Netherlands, Sweden, Thailand and the United Kingdom.

HbA1c declined more in integrated-care group than in controls

Exhibit 3

Standardized mean difference in HbA1c and 95% confidence intervals[1]



1 Trial authors and estimates are listed in Exhibit 4.
Source: See appendix for full details.

Trial names and estimates are listed in the order displayed in Exhibit 3.

Exhibit 4

Study identifier	Estimate (95% confidence intervals)
Ko SH	0.80
Gary TL (Trial Arm C)	0.80
Keyserlinger TC (Trial Arm A)	0.70
Legorreta AP (Study Arm 2)	0.6 (–0.67, 1.87)
Keyserlinger TC (Trial Arm B)	0.50
Krier BP	0.50
Thomas PD	0.4 (0.07, 0.73)
Odegard PS	0.4 (–0.27, 1.07)
Mayer-Davis EJ (Trial Arm A)	0.28
O'Connor PJ	0.2 (–0.63, 1.03)
Goudswaard AN	0.20
Krein SL	0.13
Shibayama T	0.10
O'Connor PJ	0.1 (–0.63, 1.03)
Glasgow RE	0.1 (–0.62, 0.82)
West DS	0.08
Gabbay RA	0.01 (–0.46, 0.48)
Smith SA	0 (–0.53, 0.53)
Armour CL	0 (–0.51, 0.51)
Fukuda H	0 (–0.55, 0.55)
Sadur CN	0 (–0.56, 0.56)
Naji S	0 (–0.42, 0.42)
Sone H	–0.05
Dale J	–0.07 (–0.46, 0.32)
Samuel-Hodge CD	–0.08 (–0.39, 0.22)
Hiss RG	–0.08 (–0.32, 0.16)
Whittemore R	–0.10
Raji A	–0.1 (–0.89, 0.69)
Stroebel RJ	–0.1 (–0.47, 0.27)
Kinmonth AL	–0.1 (–0.28, 0.08)
de Weerdt I (Trial Arm B)	–0.1 (–0.37, 0.17)
Steed L	–0.11
Anderson RM	–0.12
Piette JD	–0.13 (–0.37, 0.11)
Ridgeway NA	–0.14 (–1.71, 1.43)
Farmer AJ	–0.16 (–0.6, 0.28)
Ahring KK	–0.17 (–0.81, 0.47)
Hiss RG	–0.2 (–0.27, 0.13)
Piette JD	–0.2 (–0.6, 0.2)
Franz MJ	–0.2 (–0.7, 0.3)
de Weerdt I (Trial Arm A)	–0.2 (–0.63, 0.23)
Kronsbein P	–0.20
Shea S	–0.25 (–0.45, –0.05)
Adolfsson ET	–0.30
Ko GT	–0.30
Gary TL (Trial Arm B)	–0.30
Polonsky WH	–0.3 (–0.66, 0.07)
Uusitupa MI	–0.30
Young RJ	–0.31
Gary TL (Trial Arm A)	–0.31
Toobert DJ	–0.34
Walker EA	–0.36 (–0.69, –0.03)
Lorig K	–0.36 (–0.83, 0.11)
Doucette WR	–0.39 (–1.1, 0.32)
Litaker D	–0.39 (–0.71, –0.07)
McMahon GT	–0.4 (–1.02, 0.22)
Hurwitz B	–0.4 (–1.1, 0.3)
Estey AL	–0.40
Vinicor F (Trial Arm C)	–0.42 (–1.45, 0.61)
Mayer-Davis EJ (Trial Arm B)	–0.44
Samaras K	–0.49
Piatt GA	–0.5 (–1.5, 0.5)
Kirk A	–0.50
Sarkadi A	–0.50
Di Loreto C	–0.50
Miller CK	–0.50
Olivarius NF	–0.50
Vinicor F (Trial Arm B)	–0.5 (–1.48, 0.48)
Sun J	–0.54 (–0.89, –0.19)
Benjamin EM	–0.56 (–1.48, 0.36)
Gaede P	–0.57 (–0.89, –0.24)
Montori VM	–0.59 (–1.35, 0.17)
de Sonnaville JJ	–0.6 (–1.03, –0.17)
Weinberger M	–0.6 (–1.31, 0.11)
Wattana C	–0.61
Kim MT	–0.66 (–1.11, –0.21)
Hirsch IB	–0.67 (–1.47, 0.13)
Kulkarni K	–0.67 (–1.51, 0.17)
Taylor CB	–0.70
Menard J	–0.71 (–1.2, –0.22)
Pieber TR	–0.72 (–0.83, –0.61)
Skelly AH	–0.73
Brown SA	–0.76
Medi-Cal T2D Study Group	–0.77 (–0.81, –0.73)
Mazzuca SA	–0.78 (–1.55, –0.01)
Taylor CB	–0.79
King AB	–0.8 (–1.53, –0.07)
Rachmani R	–0.80
Rothman RL	–0.8 (–1.49, –0.11)
Rosal MC	–0.85
O'Connor PJ	–0.9 (–1.39, –0.41)
Thompson DM	–0.98 (–1.59, –0.37)
Wolf AM	–1 (–1.68, –0.32)
Gaede P	–1.00
Scott DM	–1.02 (–1.68, –0.36)
Ralston JD	–1.1 (–2.04, –0.16)
Aubert RE	–1.1 (–1.6, –0.6)
D'Eramo Melkus Ga (Trial Arm B)	–1.14 (–3.33, 1.05)
Bogner HR	–1.2 (–1.56, 0.84)
Choe HM	–1.2 (–2.29, –0.11)
Kim HS	–1.2 (–1.82, –0.58)
Domenech MJ	–1.3 (–3.38, 0.78)
Cramer JS	–1.33
Vinicor F (Trial Arm A)	–1.48 (–2.6, –0.36)
Maislos	–1.50
Trento M	–1.60
Oh JA	–1.80
Song MS	–1.90
Jaber LA	–2.1 (–3.86, –0.34)
Legorreta AP (Study Arm 1)	–2.2 (–2.95, –1.45)
Agurs-Collins TD	–2.40
D'Eramo Melkus Ga (Trial Arm A)	–2.48 (–4.41, –0.55)

In addition to the meta-analysis of individual trials, we also examined the systematic reviews to identify the component interventions most often associated with effective integrated-care programs. This research was based on reviewing the inclusion criteria that the systematic-review authors used to identify relevant studies. The results of this analysis provide an indication of the probable relative importance of different core elements in integrated-care program design but should not be interpreted as an assessment of the individual impact of each component, because the components were not implemented or measured in isolation. Nor are they in any sense additive. Finally, inclusion/exclusion criteria tend to describe components of treatment, rather than system enablers, and in all events are based on the initial hypotheses of the review authors.

This review of the evidence suggests that the critical elements of any integrated-care program include (but are not necessarily limited to) patient education, engagement, and empowerment; multidisciplinary clinician teams; proactive care coordination and case management; and personalized care planning (Exhibit 5).

Studies suggest common elements of successful integrated-care programs

Exhibit 5

Review of findings from 34 systematic reviews of integrated care published in last 10 years[1]

Intervention	Reviews showing positive evidence[2]	Additional insight from evidence base	Average impact[3]
Self-empowerment and education	83% (20 of 24 reviews) assessed support for self-care and found a positive impact	Supported self-management has strongest effect on clinical outcomes of all integrated-care components when estimated at component level[4]	Hospitalizations reduced by 25%–30% (interquartile range)
Multidisciplinary teams (MDTs)	81% (13 of 16 reviews) assessed MDTs and found a positive impact	All reviews have concluded that specialized follow-up of patients by a multidisciplinary team can reduce hospitalization[5]	Hospitalizations reduced by 15%–30% (interquartile range)
Care coordination	57% (8 of 13 reviews) assessed care coordination and found a positive impact	Interventions involving case management reduce HbA1c (in patients with diabetes) by 22% more than interventions without case management[6]	Hospitalizations reduced by ~37% (average from 2 reviews analyzing hospitalizations)
Individualized care plans[4]	64% (7 of 11 reviews) assessed care plans and found a positive impact	Personalized approaches using tailored information influence health behavior more than uniform approaches[7]	Hospitalizations reduced by ~23% (average from 2 reviews analyzing hospitalizations)

1 Positive impact (ie, in favor of integrated vs. usual care) on whatever outcome measures were selected by review authors (eg, disease severity, clinical markers, mortality, hospitalizations).
3 Impact measured from systematic reviews, including relevant interventions and containing meta-analysis of hospitalization rate (intervention vs, controls).
4 Cochrane review of the evidence for personalized care planning (Coulter et al.) currently in preparation (results not yet available).
4 AC Tsai et al., "A meta-analysis of interventions to improve care for chronic illnesses," American Journal of Managed Care, 11(8) (2005): 478–88
5 R Holland et al., "Systemic review of multidisciplinary interventions in heart failure," Heart, 91(7) (2005): 899–906
6 KG Shojania et al., "Effects of quality improvement strategies for type 2 diabetes on glycaemic control," Journal of the American Medical Association, 296(4) (2006): 427–40
7 Graffy et al., Primary Health Care Research and Development, 10(3) (2009): 210–22

SOURCE: See appendix (and footnotes); McKinsey analysis

Naturally, there are limitations to this research and good reasons for caution in the interpretation of these findings:

- Publication bias means ineffective interventions are less likely to be published.
- Studies rarely measure the quality and consistency of implementation.
- As previously mentioned, studies are difficult to compare because "integrated care" is a loose, umbrella term without a precise definition, and with this type of intervention, blinding is impossible, and even randomization is not always possible. The studies in this analysis are all controlled trials but not all randomized controlled trials.

Nevertheless, we believe that a reasonable person would conclude that there is significant research evidence. Furthermore, on balance, this body of evidence suggests that integrated care is an effective delivery model for people with long-term conditions, leading to improvements in patient outcomes and experience and reductions in avoidable hospital utilization. Therefore, the main challenge for health systems to debate is not *whether* to pursue integrated care, but rather *how* to do it.

* * * *

Grail Dorling is a specialist in McKinsey's London office, where Brindan Suresh is an associate principal; Tim Fountaine is a principal in the Sydney office, and Sorcha McKenna is a principal in the Dublin office.

Appendix

Appendix A

References for systematic reviews

Title	Publication	Database	Date	Authors
Systematic review of chronic care model in COPD prevention and management	Archives of Internal Medicine, 167(6): 551–61	PubMed	2007	Adams SG et al.
Collaborative care for depression and anxiety problems	Cochrane Database of Systematic Reviews, no. 10	Cochrane	2012	Archer J et al.
Effectiveness of disease management programs in depression	American Journal of Psychiatry, 160(12): 2080–90	PubMed	2003	Badamgarav E et al.
Primary care based clinics for asthma	Cochrane Database of Systematic Reviews, no. 4	Cochrane	2012	Baishnab E and Karner C
The health economic impact of disease management programs for COPD: A systematic literature review and meta-analysis	BMC Pulmonary Medicine, 13 (July 3): 40	PubMed	2013	Boland, MR et al.
Collaborative care interventions for depression in the elderly: A systematic review of randomized controlled trials	Journal of Investigative Medicine, 57(2): 446ö55	PubMed	2009	Chang-Quan H et al.
Complex interventions for preventing diabetic foot ulceration	Cochrane Database of Systematic Reviews, no. 1	Cochrane	2010	Dorresteijn JAN et al.
The effectiveness of chronic care management for heart failure: Meta-regression	Health Services Research, 47(5): 1926–59	PubMed	2012	Drewes, HW et al.
Care management for type 2 diabetes in the United States: A systematic review and meta-analysis	BMC Health Services Research, 12: 72	PubMed	2012	Eggington JS et al.
Nurse-delivered collaborative care for depression and long-term physical conditions: A systematic review and meta-analysis	Journal of Affective Disorders, 149(1–3): 14–22	PubMed	2013	Ekers, S et al.
Collaborative care for depression: A cumulative meta-analysis and review of longer-term outcomes	Archives of Internal Medicine, 166(21): 2314–21	PubMed	2006	Gilbody S et al.
Interventions used to improve control of blood pressure in patients with hypertension	Cochrane Database of Systematic Reviews, no. 3	Cochrane	2010	Glynn, LG et al.
A systematic meta-analysis of the efficacy and heterogeneity of disease management programs in congestive heart failure	Journal of Cardiac Failure, 12(7): 554–67	Additional	2006	Göhler A et al.
The effectiveness of disease management programmes in reducing hospital admission in older patients with heart failure: A systematic review and meta-analysis of published reports	European Heart Journal, 25(18): 1570–95	PubMed	2004	Gonseth J et al.
Interventions for improving outcomes in patients with multimorbidity in primary care and community settings	Cochrane Database of Systematic Reviews, no. 4	Cochrane	2012	Smith SM et al
Systematic review of multidisciplinary interventions in heart failure	Heart, 91(7): 899–906	Additional	2005	Holland R et al.
A systematic review of diabetes disease management programs	American Journal of Managed Care, 11(4): 242–50	PubMed	2005	Knight K et al.

Appendix A (continued)

Title	Publication	Database	Date	Authors
Economic effectiveness of disease management programs: A meta-analysis	Disease Management, 8(2): 114–34	Additional	2005	Krause DS
A systematic review of integrated use of disease-management interventions in asthma and COPD	Respiratory Medicine, 103(5): 670–91	PubMed	2009	Lemmens KM et al.
Multidisciplinary strategies for the management of heart failure patients at high risk for admission	Journal of the American College of Cardiology, 44(4):810–19	Additional	2004	McAlister FA et al.
Mediating the effect of self-care management intervention in type 2 diabetes: A meta-analysis of 47 randomised controlled trials	Patient Education and Counselling, 80(1): 29–41	PubMed	2010	Minet, L et al.
Efficacy of interventions to improve adherence to inhaled corticosteroids in adult asthmatics: Impact of using components of the chronic care model	Respiratory Medicine, 106(9): 1211–25	PubMed	2012	Moullec G et al.
Disease management programs for depression: A systematic review and meta-analysis of randomised controlled trials	Medical Care, 42(12): 1211–21	PubMed	2004	Neumeyer-Groman A et al.
Effectiveness of chronic obstructive pulmonary disease management programs: Systematic review and meta-analysis	American Journal of Medicine, 121(5): 433–43	PubMed	2008	Peytremann-Bridevaux I et al.
Effectiveness of disease-management programs for improving diabetes care: A meta analysis	Canadian Medical Association Journal, 183(2): E115–27	PubMed	2010	Pimouguet C et al.
Effectiveness of comprehensive disease management programmes in improving clinical outcomes in heart failure patients: A meta-analysis	European Journal of Heart Failure, 7(7): 1133–44	Additional	2005	Roccaforte R et al.
Effects of quality improvement strategies for type 2 diabetes on glycaemic control	Journal of the American Medical Association, 296(4): 427–40	Additional	2006	Shojania KG et al.
Clinical service organisation for heart failure	Cochrane Database of Systematic Reviews, no. 9	Cochrane	2012	Takeda A et al.
Effectiveness of innovations in nurse led chronic disease management for patients with COPD: Systematic review of evidence	BMJ, 331 (7515): 485–88	PubMed	2005	Taylor SJC et al.
Collaborative care to improve the management of depressive disorders: A community guide systematic review and meta-analysis	American Journal of Preventative Medicine, 42(5): 525–38	PubMed	2012	Thota AB et al.
A meta-analysis of interventions to improve care for chronic illnesses	American Journal of Managed Care, 11(8): 478–88	Additional	2005	Tsai AC et al.
Heart failure care management programs: A review of study interventions and meta-analysis of outcomes	Journal of Cardiovascular Nursing, 28(1): 8–19	PubMed	2013	Wakefield, BJ et al.
Action plans with limited patient education only for exacerbations of COPD	Cochrane Database of Systematic Reviews, no. 5	Cochrane	2010	Walters JAE et al.

Appendix B

References for individual trials included in the hospitalization analysis

Title	Citation	Authors	Year	*n*
Mode of action and effects of standardized collaborative disease management on mortality and morbidity in patients with systolic heart failure: The Interdisciplinary Network for Heart Failure (INH) Study	Circulation: Heart Failure, 5: 25–35	Angermann CE et al.	2012	715
Multicenter randomized trial of a comprehensive hospital discharge and outpatient heart failure management program	European Journal of Heart Failure, 6(5): 643–52	Atienza F et al.	2004	338
Randomized controlled trial of cardiac rehabilitation in elderly patients with heart failure	European Journal of Heart Failure, 7(3): 411–17	Austin J et al.	2005	200
Randomised controlled trial of specailist nurse intervention in heart failure	BMJ, 323(7315): 715–18	Blue L et al.	2001	165
Reduction of hospital utilization in patients with chronic obstructive pulmonary disease: A disease-specific self-management intervention	Archives of Internal Medicine, 163: 585–91	Bourbeau J et al.	2003	165
Effect of a pharmacist-led intervention on diuretic compliance in heart failure patients: A randomized controlled study	Journal of Cardiac Failure, 9(5): 404–11	Bouvy M et al.	2003	152
Cost utility ratio in chronic heart failure: Comparison between heart failure management program delivered by day hospital and usual care	Journal of the American College of Cardiology, 40(7): 1259–66	Capomolla S et al.	2002	234
Integrated care prevents hospitalisations for exacerbations in COPD patients	European Respiratory Journal, 28(1): 123–30	Casas A et al.	2006	155
Enhancing cost-effective care with a patient-centric chronic obstructive pulmonary disease programme	Population Health Management, 14(3): 133–36	Chuang C et al.	2011	282
Cost effective management programme for heart failure reduces hospitalisation	Heart, 80(5): 442–46	Cline CM et al.	1998	135
A randomized trial of two types of nurse-assisted home care for patients with COPD	Chest, 128(4): 2017–24	Coultas D et al.	2005	102
Care management for low-risk patients with heart failure: A randomized, controlled trial	Annals of Internal Medicine, 141(8): 606–13	DeBusk RF et al.	2004	462
Economic evaluation of a disease management program for chronic obstructive pulmonary disease	COPD, 8(3): 153–59	Dewan NA et al.	2011	743
Randomized controlled trial of integrated heart failure management: The Auckland Heart Failure Management Study	European Heart Journal, 23(2): 139–46	Doughty RN et al.	2002	197
Impact of care at a multidisciplinary congestive heart failure clinic: A randomized trial	Canadian Medical Association Journal, 173(1): 40–45	Ducharme A et al.	2005	230
Randomized trial of a nurse-administered, telephone-based disease management program for patients with heart failure	Journal of Cardiac Failure, 11(5): 358–65	Dunagan WC et al.	2005	151
Feasibility of a nurse-monitored, outpatient-care programme for elderly patients with moderate-to-severe chronic heart failure	European Heart Journal, 19(8): 1254–60	Ekman I et al.	1998	158
A comprehensive case management program to prevent chronic obstructive pulmonary disease hospitalizations: A randomized, controlled trial	Annals of Internal Medicine, 156(10): 673–83	Fan VS et al.	2012	426

Appendix B (continued)

Title	Citation	Authors	Year	*n*
Impact of a comprehensive heart failure management progam on hospital readmission and functional status of patients with advanced heart failure	Journal of the American College of Cardiology, 30(3): 725–32	Fonarow GG et al.	1997	428
Reduction in heart failure events by the addition of a clinical pharmacist to the heart failure management team: Results of the Pharmacist in Heart Failure Assessment Recommendation and Monitoring (PHARM) Study	Archives of Internal Medicine, 159: 1939–45	Gattiss WA et al.	1999	181
Randomised trial of telephone intervention in chronic heart failure: DIAL trial	BMJ, 331(7514): 425	GESICA	2005	1518
Does encouraging good compliance improve patients' clinical condition in heart failure?	British Journal of Clinical Practice, 49: 173–76	Goodyer LI et al.	1995	100
Quality of life of individuals with heart failure: a randomized trial of the effectiveness of two models of hospital-to-home transition	Medical Care, 40(4): 271–82	Harrison MB et al.	2002	157
Randomised controlled trial of general practice based asthma clinics	Medical Journal of Australia, 171: 68–71	Heard AR et al.	1999	191
Randomised controlled trial of home based care of patients with chronic obstructive pulmonary disease	BMJ, 325(7370): 938	Hermiz O et al.	2002	147
Home hospitalisation of exacerbated chronic obstructive pulmonary disease patients	European Respiratory Journal, 21(1): 58–67	Hernandez C et al.	2003	222
Does home based medication review keep older people out of hospital? The HOMER randomised controlled trial	BMJ 330(7486): 293	Holland R et al.	2005	71
Is INTERdisciplinary COMmunity-based COPD management (INTERCOM) cost-effective?	European Respiratory Journal, 35(1): 79–87	Hoogendoorn M et al.	2010	158
Effectiveness of team management home-based primary care: a randomized multicenter trial	JAMA, 282(22): 2877–85	Hughes SL et al.	2000	1966
Effects of education and support on self-care and resource utilization in patients with heart failure	European Heart Journal, 20(9): 673–82	Jaarsma T et al.	1999	179
Reducing the cost of frequent hospital admissions for congestive heart failure: A randomized trial of a home telecare intervention	Medical Care, 39(11): 2134–45	Jerant AF et al.	2001	37
A randomized trial of the efficacy of multidisciplinary care in heart failure outpatients at high risk of hospital readmission	Journal of the American College of Cardiology, 39(3): 471–80	Kasper EK et al.	2002	200
Randomized trial of a depression management program in high utilizers of medical care	Archives of Family Medicine, 9(4): 345–51	Katzelnick DJ et al.	2000	407
Randomized trial of an education and support intervention to prevent readmission of patients with heart failure	Journal of the American College of Cardiology, 39(1): 83–89	Krumholz HM et al.	2002	88
Case management in a heterogeneous congestive heart failure population: A randomized controlled trial	Archives of Internal Medicine, 163(7): 809–17	Laramee AS et al.	2003	256
Heart failure management: Multidisciplinary care has intrinsic benefit above the optimization of medical care	Journal of Cardiac Failure, 8(3): 142–48	McDonald K et al.	2002	98

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Title	Citation	Authors	Year	*n*
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Case management may reduce length of hospital stay in patients with recurrent admissions for chronic obstructive pulmonary disease	Respirology, 6(1): 37–42	Poole PJ et al.	2001	32
Impact of pharmacist interventions on hospital readmissions for heart failure	American Journal of Health-System Pharmacy, 56(13): 1339–42	Rainville EC	1999	34
A chronic disease management programme can reduce days in hospital for patients with chronic obstructive pulmonary disease	Internal Medicine Journal, 34(11): 608–14	Rea H et al.	2004	135
A multidisciplinary intervention to prevent the readmission of elderly patients with congestive heart failure	New England Journal of Medicine, 333(18): 1190–95	Rich MW et al.	1995	282
Prevention of readmission in elderly patients with congestive heart failure: Results of a prospective, randomized pilot study	Journal of General Internal Medicine, 8(11): 585–90	Rich MW et al.	1993	98
Effect of a standardized nurse case-management telephone intervention on resource use in patients with chronic heart failure	Archives of Internal Medicine, 162(6): 705–12	Riegel B et al.	2002	358
A nurse led intermediate care package in patients who have been hospitalised with an acute exacerbation of chronic obstructive pulmonary disease	Thorax, 63(3): 194–200	Sridhar M et al.	2008	104
Home-based intervention in congestive heart failure: Long-term implications on readmission and survival	Circulation, 105(24): 2861–66	Stewart S and Horowitz JD	2002	297
Effects of a home-based intervention among patients with congestive heart failure discharged from acute hospital care	Archives of Internal Medicine, 158(10): 1067–72	Stewart S et al.	1998	97
Effects of a multidisciplinary, home-based intervention on unplanned readmissions and survival among patients with chronic congestive heart failure: A randomised controlled study	Lancet, 354(9184): 1077–83	Stewart S et al.	1999	200
Nurse-led heart failure clinics improve survival and self-care behaviour in patients with heart failure: Results from a prospective, randomised trial	European Heart Journal, 24(11): 1014–23	Strömberg A et al.	2003	106
Home-based disease management program to improve psychological status in patients with heart failure in Japan	Circulation Journal, 77(4): 926–33	Tsuchihashi-Makaya M et al.	2013	161
A multicenter disease management program for hospitalized patients with heart failure	Journal of Cardiac Failure, 10(6): 473–80	Tsuyuki RT et al.	2004	276
Pharmaceutical care of patients with congestive heart failure: Interventions and outcomes	Pharmacotherapy, 19(7): 860–69	Varma S et al.	1999	83
Does increased access to primary care reduce hospital readmission? Veterans Affairs Cooperative Study Group on Primary Care and Hospital Readmission	New England Journal of Medicine, 334(22): 1441–47	Weinberger M et al.	1996	504
Cost-effectiveness of a health-social partnership transitional program for post-discharge medical patients	BMC Health Services Research, 12: 479	Wong FK et al.	2012	555

Appendix C

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Title	Citation	Authors	Year	*n*
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A randomized controlled trial of weight reduction and exercise for diabetes management in older African-American subjects	Diabetes Care, 20(10): 1503–11	Agurs-Collins TD et al.	1997	55
Telephone modem access improves diabetes control in those with insulin-requiring diabetes	Diabetes Care, 15(8): 971–75	Ahring KK et al.	1992	42
Impact of community pharmacy diabetes monitoring and education programme on diabetes management: A randomized controlled study	Diabetic Medicine, 29(9): 326–33	Ali M et al.	2012	46
Evaluating a problem-based empowerment program for African Americans with diabetes: Results of a randomized controlled trial	Ethnicity and Disease, 15(4): 671–78	Anderson RM et al.	2005	225
Implementation and evaluation of Australian pharmacists' diabetes care service	Journal of the American Pharmacists Association, 44(4): 455–66	Armour CL et al.	2004	145
Nurse care management to improve glycemic control in diabetic patients in a health maintenance organization: A randomized, controlled trial	Annals of Internal Medicine, 129(8): 605–12	Aubert RE et al.	1998	138
Implementing practice guidelines for diabetes care using problem-based learning: A prospective controlled trial using firm systems	Diabetes Care, 22(10): 1672–78	Benjamin EM et al.	1999	106
Integrated management of type 2 diabetes mellitus and depression treatment to improve medication adherence: A randomized controlled trial	Annals of Family Medicine, 10(1): 15–22	Bogner HR et al.	2012	180
Improved outcomes in diabetes care for rural African Americans	Annals of Family Medicine, 11(2): 145–50	Bray P et al.	2013	727
Culturally competent diabetes self-management education for Mexican Americans: The Starr County border health initiative	Diabetes Care, 25(2): 259–68	Brown SA et al.	2002	224
Closing the gap: effect of diabetes case management on glycaemic control among low-income ethnic minority populations: The California Medi-Cal type 2 diabetes study	Diabetes Care, 27(1): 95–103	California Medi-Cal Type 2 Diabetes Study Group	2004	362
Proactive case management of high-risk patients with type 2 diabetes mellitus by a clinical pharmacist: A randomized controlled trial	American Journal of Managed Care, 11(4): 253–60	Choe HM et al.	2005	120
An adaptation of the diabetes prevention program for use with high-risk, minority patients with type 2 diabetes	Diabetes Educator, 33(3): 503–508	Cramer JS et al.	2007	51
Telephone peer-delivered intervention for diabetes motivation and support: The telecare exploratory RCT	Patient Education and Counseling, 75(1): 91–98	Dale J et al.	2009	141
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Appendix C (continued)

Title	Citation	Authors	Year	*n*
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Validation of a counseling strategy to promote the adoption and the maintenance of physical activity by type 2 diabetic subjects	Diabetes Care, 26(2): 404–408	Di Loreto C et al.	2003	321
Evaluation of the effectiveness of an ambulatory teaching/treatment programme for non-insulin dependent (type 2) diabetic patients	Acta Diabetologica, 32(3): 143–47	Domenech MI et al.	1995	30
Community pharmacist-provided extended diabetes care	Annals of Pharmacotherapy, 43(5): 882–89	Doucette WR et al.	2009	78
Follow-up intervention: Its effect on compliance behavior to a diabetes regimen	Diabetes Educator, 16(4): 291–95	Estey AL et al.	1990	53
A randomized controlled trial of the effect of real-time telemedicine support on glycemic control in young adults with type 1 diabetes	Diabetes Care, 28(11): 2697–2702	Farmer AJ et al.	2005	93
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Effectiveness of medical nutrition therapy provided by dietitians in the management of non-insulin-dependent diabetes mellitus: A randomized, controlled clinical trial	Journal of the American Dietetic Association, 95(9): 1009–17	Franz MJ et al.	1995	179
Evaluation of a diabetes patient education program consisting of a three-day hospitalization and a six-month follow-up by telephone counseling for mild type 2 diabetes and IGT	Environmental Health and Preventive Medicine, 4(3): 122–29	Fukuda H et al.	1999	52
Nurse case management improves blood pressure, emotional distress and diabetes complication screening	Diabetes Research and Clinical Practice, 71(1): 28–35	Gabbay RA et al.	2006	332
Intensified multifactorial intervention in patients with type 2 diabetes mellitus and microalbuminuria: The Steno type 2 randomised study	Lancet, 353(9153): 617–22	Gaede P et al.	1999	160
Limited impact of lifestyle education to patients with type 2 diabetes mellitus and microalbuminuria: Results from a randomized intervention study	Diabetic Medicine, 18(2): 104–108	Gaede P et al.	2003	149
Randomized controlled trial of the effects of nurse case manager and community health worker interventions on risk factors for diabetes-related complications in urban African Americans	Preventive Medicine, 37(1): 23–32	Gary T et al.	2003	217
Brief, computer-assisted diabetes dietary self-management counseling: Effects on behavior, physiological outcomes, and quality of life	Medical Care, 38(11): 1062–73	Glasgow RE and Toobert DJ	2000	320
The D-Net diabetes self-management program: Long term implementation, outcomes, and generalization results	Preventive Medicine, 36(4): 410–19	Glasgow RE et al.	2003	160
Long-term effects of self-management education for patients with type 2 diabetes taking maximal oral hypoglycaemic therapy: A randomized trial in primary care	Diabetic Medicine, 21(5): 491–96	Goudswaard AN et al.	2004	50

Appendix C (continued)

Title	Citation	Authors	Year	*n*
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Comprehensive evaluation of community-based diabetic patients: Effect of feedback to patients and their physicians: A randomized controlled trial	Diabetes Care, 24(4): 690–94	Hiss RG et al.	2001	197
Nurse care manager collaboration with community-based physicians providing diabetes care: A randomized controlled trial	Diabetes Educator, 33(3): 493–502	Hiss RG et al.	2007	197
Sharing the care of diabetic patients between hospital and general practitioners: Does it work?	Diabetic Medicine, 10(1): 81–86	Hoskins PL et al.	1993	134
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Evaluation of a pharmaceutical care model on diabetes management	Annals of Pharmacotherapy, 30(3): 238–43	Jaber LA et al.	1996	39
A randomized trial of an intervention to improve self-care behaviors of African-American women with type 2 diabetes: Impact on physical activity	Diabetes Care, 25(9): 1576–83	Keyserlinger T et al.	2002	229
Adherence to diabetes control recommendations: Impact of nurse telephone calls	Journal of Advanced Nursing, 44(3): 256–61	Kim HS and Oh JA	2003	36
A community-based, culturally tailored behavioral intervention for Korean Americans with type 2 diabetes	Diabetes Educator, 35(6): 986–94	Kim MT et al.	2009	79
Evaluation of a diabetes specialist-guided primary care diabetes treatment program	Journal of the American Academy of Nurse Practitioners, 21(1): 24–30	King AB and Wolfe GS	2009	135
Randomised controlled trial of patient centred care of diabetes in general practice: Impact on current wellbeing and future disease risk	BMJ, 317: 1202–1208	Kinmonth AL et al.	1998	231
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Long-term effects of a structured intensive diabetes education programme (SIDEP) in patients with type 2 diabetes mellitus: A 4-year follow-up study	Diabetic Medicine, 24(1): 55–62	Ko SH et al.	2007	308
Case management for patients with poorly controlled diabetes: A randomized trial	American Journal of Medicine, 116(11): 732–39	Krein SL et al.	2004	209
Effect of diabetes education on glucose control	Journal of the Louisiana State Medical Society, 151(2): 86–92	Krier BP et al.	1999	23
Evaluation of a structured teaching and treatment programme on non-insulin-dependent diabetes	Lancet, 2(8625): 1407–11	Kronsbein P et al.	1988	99
Nutrition Practice Guidelines for Type 1 Diabetes Mellitus positively affect dietitian practices and patient outcomes	Journal of the American Dietetic Association, 98(1): 62–70	Kulkarni K et al.	1998	54

Appendix C (continued)

Title	Citation	Authors	Year	*n*
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Effect of a comprehensive nurse-managed diabetes program: An HMO prospective study	American Journal of Managed Care, 2: 1024–30	Legorreta AP et al.	1996	390
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Pounds off with empowerment (POWER): A clinical trial of weight management strategies for black and white adults with diabetes who live in medically underserved rural communities	American Journal of Public Health, 94 (10): 1736–42	Mayer-Davis EJ et al. (Trial Arm A)	2004	103
Pounds off with empowerment (POWER): A clinical trial of weight management strategies for black and white adults with diabetes who live in medically underserved rural communities	American Journal of Public Health, 94(10): 1736–43	Mayer-Davis EJ et al. (Trial Arm B)	2004	105
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Web-based care management in patients with poorly controlled diabetes	Diabetes Care, 28(7): 1624-9	McMahon GT et al.	2005	104
Diabetes education and care management significantly improve patient outcomes in the dialysis unit	American Journal of Kidney Diseases, 40(3): 566–75	McMurray SD et al.	2002	83
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Efficacy of intensive multi-therapy for patients with type 2 diabetes mellitus: A randomized controlled trial	CMAJ, 173(12): 1457–66	Ménard J et al.	2005	72
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Integrated care for diabetes: Clinical, psychosocial, and economic evaluation	BMJ, 308: 1208–12	Naji S et al.	1994	226
Continuous quality improvement can improve glycemic control for HMO patients with diabetes	Archives of Family Medicine, 5(9): 502–506	O'Connor PJ et al.	1996	186
Impact of an electronic medical record on diabetes quality of care	Annals of Family Medicine, 3(4): 300–306	O'Connor PJ et al.	2005	122
Randomized trial of quality improvement intervention to improve diabetes care in primary care settings	Diabetes Care, 28(8): 1890–97	O'Connor PJ et al.	2005	754

Appendix C (continued)

Title	Citation	Authors	Year	*n*
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A telephone-delivered intervention to improve glycemic control in type 2 diabetic patients	Yonsei Medical Journal, 44(1): 1–8	Oh JA et al.	2003	38
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Treatment of high-risk patients with diabetes: Motivation and teaching intervention: A randomized, prospective 8-year follow-up study	Journal of the American Society of Nephrology, 16 (supp 1): S22–26	Rachmani R et al.	2005	110
A randomized trial comparing intensive and passive education in patients with diabetes mellitus	Archives of Internal Medicine, 162(11): 1301–1304	Raji A et al.	2002	106
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Improved control of type 2 diabetes mellitus: A practical education/behavior modification program in a primary care clinic	Southern Medical Journal, 92(7): 667–72	Ridgeway NA et al.	1999	38
Diabetes self-management among low-income Spanish-speaking patients: A pilot study	Annals of Behavioral Medicine, 29(3): 225–35	Rosal MC et al.	2005	23
A randomized trial of a primary care–based disease management program to improve cardiovascular risk factors and glycated hemoglobin levels in patients with diabetes	American Journal of Medicine, 118(3): 276–84	Rothman RL et al.	2005	217
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Will older sedentary people with non-insulin-dependent diabetes mellitus start exercising? A health promotion model	Diabetes Research and Clinical Practice, 37(2): 121–28	Samaras K et al.	1997	24
A randomized trial of a church-based diabetes self-management program for African Americans with type 2 diabetes	Diabetes Educator, 35(3): 439–54	Samuel-Hodge CD et al.	2009	201
Experience-based group education in type 2 diabetes: A randomised controlled trial	Patient Education and Counseling, 53(3): 291–98	Sarkadi A and Rosenqvist U	2004	64

Appendix C (continued)

Title	Citation	Authors	Year	*n*
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A randomized trial comparing telemedicine case management with usual care in older, ethnically diverse, medically underserved patients with diabetes mellitus: 5 year results of the IDEATel study	Journal of the American Medical Informatics Association, 2009, 16(4): 446-57	Shea S et al.	2009	1665
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Chronic care model and shared care in diabetes: Randomized trial of an electronic decision support system	Mayo Clinic Proceedings, 83(7): 747–57	Smith SA et al.	2008	639
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An integrated intervention program to control diabetes in overweight Chinese women and women with type 2 diabetes	Asia Pacific Journal of Clinical Nutrition, 17(3): 514–24	Sun J et al.	2008	150
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Evaluation of a nurse-care management system to improve outcomes in patients with complicated diabetes	Biological Research for Nursing, 6(3), 207-15	Taylor KI et al	2006	39
Evaluation of a nurse-care management system to improve outcomes in patients with complicated diabetes	Diabetes Care, 26(4): 1058–63	Taylor CB et al.	2003	169
Evaluation of the “Know Your Health” program for type 2 diabetes mellitus and hypertension in a large employer group	American Journal of Managed Care, 12: SP33–39	Thomas PD and Miceli R	2006	347
Insulin adjustment by a diabetes nurse educator improves glucose control in insulin-requiring diabetic patients: A randomized trial	CMAJ, 161(8): 959–62	Thompson DM et al.	1999	46
Biologic and quality of life outcomes from the Mediterranean Lifestyle Program: A randomized clinical trial	Diabetes Care, 26(8): 2288–93	Toobert DJ et al.	2003	251
Lifestyle intervention by group care prevents deterioration of type II diabetes: A 4-year randomized controlled clinical trial	Diabetologia, 45(9): 1231–39	Trento M et al.	2002	90

Appendix C (continued)

Title	Citation	Authors	Year	*n*
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Early lifestyle intervention in patients with non-insulin-dependent diabetes mellitus and impaired glucose tolerance	Annals of Medicine, 28(5): 445-9	Uusitupa MI	1996	78
DIABEDS: A randomized trial of the effect of physician and/or patient education on diabetes patient outcomes	Journal of Chronic Diseases, 40(4): 345–56	Vinicor F et al.	1987	381
Results of a successful telephone intervention to improve diabetes control in urban adults: A randomized trial	Diabetes Care, 34(1): 2–7	Walker EA et al.	2011	526
Effects of diabetes self-management program on glycemic control, coronary heart disease risk, and quality of life among Thai patients with type 2 diabetes	Nursing and Health Sciences, 9(2): 135–41	Wattana C et al.	2007	147
A nurse coordinated intervention for primary care patients with non-insulin-dependent diabetes mellitus: Impact on glycemic control and health-related quality of life	Journal of General Internal Medicine, 10(2): 59–66	Weinberger M et al.	1995	251
Motivational interviewing improves weight loss in women with type 2 diabetes	Diabetes Care, 30(5): 1081–87	West DS et al.	2007	202
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A nurse-coaching intervention for women with type 2 diabetes	Diabetes Educator, 30(5): 795–804	Whittemore R et al.	2004	45
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