Effectiveness of quality improvement strategies for coordination of care to reduce use of health care services: a systematic review and meta-analysis

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See related commentary, www.cmaj.ca/lookup/doi/10.1503/cmaj.141050

ABSTRACT

Background: Frequent users of health care services are a relatively small group of patients who account for a disproportionately large amount of health care utilization. We conducted a meta-analysis of the effectiveness of interventions to improve the coordination of care to reduce health care utilization in this patient group.

Methods: We searched MEDLINE, Embase and the Cochrane Library from inception until May 2014 for randomized clinical trials (RCTs) assessing quality improvement strategies for the coordination of care of frequent users of the health care system. Articles were screened, and data abstracted and appraised for quality by 2 reviewers, independently. Random effects meta-analyses were conducted.

Results: We identified 36 RCTs and 14 companion reports (total 7494 patients). Significantly fewer patients in the intervention group than in the control group were admitted to hospital (relative risk [RR] 0.81, 95% confidence interval [CI] 0.72–0.91). In subgroup analyses, a similar effect was observed among patients with chronic medical conditions other than mental illness, but not among patients with mental illness. In addition, significantly fewer patients 65 years and older in the intervention group than in the control group visited emergency departments (RR 0.69, 95% CI 0.54–0.89).

Interpretation: We found that quality improvement strategies for coordination of care reduced hospital admissions among patients with chronic conditions other than mental illness and reduced emergency department visits among older patients. Our results may help clinicians and policy-makers reduce utilization through the use of strategies that target the system (team changes, case management) and the patient (promotion of self-management).

Frequent users of health care services represent a relatively small group of patients who account for a disproportionately large amount of health care utilization, including emergency department visits,[1,2] hospital admissions and clinic visits. These patients are often of low socioeconomic status,[3,4] have multiple medical, psychiatric and social disorders[5,6] and have a high mortality.[7] Frequent use of the health care system contributes to longer wait times and affects the quality of care.[4,8]

Disproportionate use of health care services by a segment of the population has been identified as a challenge in many countries, including Canada.[9–12] To encourage less resource-intensive care for frequent users, many efforts have been implemented. Some of these interventions, for example, have been designed specifically to transition health care utilization away from the hospital to other settings, such as community-based clinics.[13]

Much of the literature has focused on frequent users of emergency departments, with less focus on their use of the health care system in general. One systematic review identified a number of studies that assessed the effect of various interventions, including care coordination.[14] The authors concluded that case management and multidisciplinary teams were likely effective interventions to reduce emergency department visits.

Emergency department visits typically represent only a fraction of the cost burden on the health care system. There is a need to understand the impact of interventions aimed at reducing overall health care utilization, including hospital admissions. We conducted a systematic review and meta-analysis of the effectiveness of quality improvement strategies

for care coordination for patients who are frequent users of the health care system.

Methods

We developed our protocol according to the PRISMA-P (Preferred Reporting Items for Systematic review and Meta-analysis Protocols) statement (available from the authors).

Literature search

The search strategies were developed by an experienced librarian and were reviewed by a second librarian using the Peer Review of Electronic Search Strategies checklist.[15] A comprehensive search of MEDLINE, Embase and the Cochrane Library was conducted from inception until May 5, 2014, and was limited to adults and humans. The MEDLINE search strategy, outlined in Appendix 1 (available at www.cmaj.ca/lookup /suppl/doi:10.1503/cmaj.140289/-/DC1), was modified for the Embase and Cochrane Library searches with the use of appropriate medical subject headings (available upon request). We also searched trial registries and conference abstracts, scanned the reference lists of included studies and relevant reviews, contacted authors to request other potentially relevant studies, searched the 10 most related citations in PubMed for each included study and searched studies that referenced the included studies in Web of Science (i.e., forward citation searching).

Study selection

Before screening began, a calibration exercise was conducted to ensure high reliability in correctly selecting articles for inclusion. This exercise entailed screening a random sample of 75 citations (titles and abstracts) using Synthesi.SR (a proprietary online systematic review tool developed by the Joint Program in Knowledge Translation at St. Michael's Hospital, Toronto). The percentage agreement among these reviewers was quantified. After high agreement was achieved, each citation was screened by 2 authors using the predefined relevance criteria form. Discrepancies were resolved by discussion or the involvement of a third reviewer. The same process was followed for full-text review of potentially relevant articles identified through citation screening. When eligibility of a particular study was unclear, the study's authors were contacted for additional information.

Eligible studies were randomized clinical trials (RCTs) that assessed at least 1 of 5 predefined quality improvement strategies targeting adult patients (age ≥ 18 yr) who were frequent users of the health care system. The quality

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Box 1: Description of quality improvement strategies[17]

Care coordination

Care coordination is the deliberate organization of patient care activities between 2 or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of health care services. Organizing care involves the marshalling of personnel and other resources needed to carry out all required patient care activities; it is often managed by the exchange of information among participants responsible for different aspects of care.[15]

- *Case management:* The coordination of patient care, including diagnosis, treatment and ongoing patient management (e.g., arranging referrals, follow-up of test results, patient education, patient reminders) by an individual other than the primary care clinician.[18]

- *Team changes:* Changes to the primary health care team and how it functions, including routine patient visits with personnel other than the primary care physician, use of multidisciplinary teams and the expansion or revision of team members' professional roles.[18]

- *Promotion of self-management:* Providing equipment (e.g., home glucometers for patients with diabetes) or access to resources (e.g., electronic systems for transferring glucose measurements for patients with diabetes) and establishing joint goals to empower patients to manage their disease on their own.[18]

- *Decision support:* Operational process of adjustment for a system that generates regular feedback (from registry data) to clinical teams on guideline compliance or organizational support to facilitate other mechanisms for coordinating care.[19]

- *Clinical information system:* A quality improvement strategy encompassing numerous systems performing a wide variety of functions; distinguished from administrative information systems by the requirement for data entry or data retrieval by clinicians at the point of care.[20]

Additional components

- *Patient navigator:* "Guide people through the health care maze, connecting them with the right doctors and helping them gain access to available therapies."[21]

- *Outreach activities:* Assessment, education or follow-up conducted outside the clinic or hospital, in or near the patient's home.

Other quality improvement strategies

- *Patient education:* Educating patients about their disease, including prevention and treatment strategies.[18]

- *Patient reminder systems:* Reminding patients about upcoming appointments or important aspects of self-care (e.g., glucose monitoring for patients with diabetes).[18]

- *Clinician education:* Educating clinicians about a particular condition or illness that their patients might face, including strategies for prevention and treatment (e.g., based on clinical practice guidelines); may be conducted through conferences, workshops, distribution of educational materials and one-on-one educational outreach meetings (or academic detailing).[18]

- *Clinician reminders:* Reminding clinicians to look up patients' clinical information or to conduct specific tasks.[18]

- *Audit and feedback:* Generating summaries of clinic's or individual clinician's performance, which are transmitted back to the clinician.[18]

- *Financial incentives:* Providing clinicians with financial incentives for reaching pre-established goals or achievements; may also include incentives for patients or system-wide changes in reimbursement.[18]

- *Continuous quality improvement:* Using specific processes to identify quality problems, developing solutions, and implementing and evaluating changes; may include interventions, such as total quality management or plan–do–study–act.[18]

- *Facilitated relay of information to clinicians:* Transmitting clinical information from patients to clinicians by means other than the existing medical record.[18]

improvement interventions of interest, chosen to fill gaps in the "expanded chronic care model"[16] and described in Box 1,[15,17–21] are closely related to care coordination: case management, team changes, promotion of self-management, decision support, and clinical information systems. We also considered the effects of 2 additional components to an intervention: patient navigators and outreach activities.

Quality improvement strategies were compared with usual care, no intervention or other quality improvement strategies, as listed in Box 1. When more than one control arm was available in the studies, we chose the usual-care arm for inclusion in the analysis. Included studies had to report at least one of the eligible health utilization outcomes, specifically emergency department visits, hospital admissions or clinic visits; the proportion of patients was the primary outcome of interest. Studies written in any language, whether published or unpublished, and conducted at any point in time were eligible for inclusion.

Data collection

A data abstraction form was drafted and pilot-tested by 8 of us (A.C.T., N.M.I., H.M.A., P.A.K., E.B., M.G., H.M. and L.K.E.) working independently on a random sample of 5 articles. Data items we recorded were study characteristics (e.g., setting, type of study design), patient characteristics (e.g., population examined, mean age), quality improvement strategies examined and utilization outcomes examined. Two reviewers (A.C.T.,

N.M.I., H.M.A., P.A.K., E.B., M.G., H.M. or L.K.E.) independently read each article and abstracted the relevant data. Differences in abstraction were resolved by team discussion. Because it is often difficult to classify quality improvement strategies, classification of strategies was performed independently by a systematic review methodologist and a clinician. Conflicts were resolved through discussion. Attempts were made to identify related publications (referred to as companion reports). Study authors were contacted via email for clarification of data if necessary (e.g., unreported standard deviations for continuous data, mean age of included patients).

Appraisal of risk of bias

We used the Cochrane Effective Practice and Organisation of Care Risk-of-Bias Tool to assess risk of bias.[22] Each included article was independently appraised by 2 reviewers (A.C.T., N.M.I., H.M.A., P.A.K., E.B., M.G., H.M. or L.K.E.). Conflicts were resolved by discussion or the involvement of a third reviewer (A.C.T. or S.E.S.).

Data synthesis

We used a random-effects meta-analysis to combine data for outcomes reported in at least 2 RCTs.[16] Mean differences were calculated for studies reporting the average number of visits per patient per month (i.e., continuous outcomes), and relative risks (RRs) were calculated for studies reporting the proportion of patients with visits (i.e., dichotomous outcomes). Funnel plots were created to identify potential publication bias.[23]

Before conducting the meta-analysis, we examined 3 types of heterogeneity: clinical (e.g., type of patient population, setting), methodologic (e.g., quality improvement strategy examined) and statistical (e.g., I^2 statistic).[24] Our approach for dealing with significant heterogeneity was to conduct appropriate subgroup analyses. We conducted post hoc subgroup analyses to determine the influence of the following factors: type of patient (primarily those with mental illness v. those with chronic medical conditions other than mental illness; and age $\geq$ 65 yr v. < 65 yr), and type of frequent user based on the RCT eligibility criteria (at risk of being a frequent user = having a history of inpatient care with other predisposing factors, such as multiple comorbidities or psychosocial morbidity; low utilization = "frequent use" defined as 1 to 2 contacts with the health care system in the past year among patients with multiple comorbidities or psychosocial morbidity; moderate utilization = 3 to 4 contacts with the health care system in the past year; and most frequent/severe utilization = $\geq$ 5 contacts with the health care system in the past year).
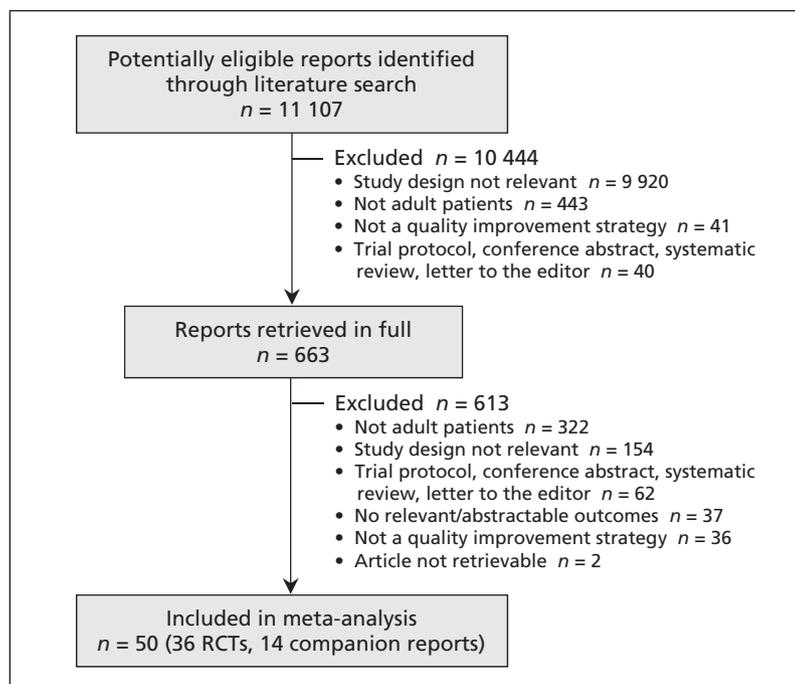

Figure 1: Selection of articles for the meta-analysis. RCT = randomized clinical trial.

Flowchart content:

Potentially eligible reports identified through literature search
n = 11 107

Excluded n = 10 444
• Study design not relevant n = 9 920
• Not adult patients n = 443
• Not a quality improvement strategy n = 41
• Trial protocol, conference abstract, systematic review, letter to the editor n = 40

Reports retrieved in full
n = 663

Excluded n = 613
• Not adult patients n = 322
• Study design not relevant n = 154
• Trial protocol, conference abstract, systematic review, letter to the editor n = 62
• No relevant/abstractable outcomes n = 37
• Not a quality improvement strategy n = 36
• Article not retrievable n = 2

Included in meta-analysis
n = 50 (36 RCTs, 14 companion reports)

Results

Search results and study characteristics

Of the 11 107 citations identified through the literature search, 663 full-text articles were reviewed. After exclusion of 613 articles for various reasons (Figure 1), we included 36 RCTs (total 7 494 patients)[25–60] plus an additional 14 companion reports.[61–74]

The studies were published between 1987 and 2014 by researchers in North America (*n* = 24), Europe (*n* = 8), Australia (*n* = 2), Israel (*n* = 1) and South Africa (*n* = 1) (Table 1). One study was a cluster RCT. The duration of follow-up ranged from 1 to 36 months.

The definition of a frequent user of health care services varied across the studies. Some studies included patients who were at risk of being frequent users (*n* = 11 studies), whereas others included patients with low utilization (*n* = 8 studies), moderate utilization (*n* = 2 studies) or the most frequent/severe utilization (*n* = 15 studies). (Additional study and patient characteristics are shown in Appendix 2, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.140289/-/DC1). Most of the studies included patients with a primary diagnosis of mental illness; 14 studies included patients with a chronic medical condition other than mental illness (Table 1). Twelve studies included patients with severe mental health conditions, such as schizophrenia and substance abuse disorders, and 12 studies included patients who were homeless. The mean age of participants ranged from 28.1 to 81.6 years. The studies included from 25% to 77% women (Appendix 2).

Care coordination strategies

The following strategies were used to improve care coordination: case management (*n* = 29 studies), team changes (*n* = 21), self-management (*n* = 19) and clinical information systems (*n* = 1) (details about the strategies are included in Appendices 3 and 4, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.140289/-/DC1). The number of quality improvement strategies examined per study ranged from 1 to 5 (median 2.5). The intervention included outreach activities in 23 studies and patient navigators in 6 studies. The comparator group received patient education in 1 study or low-intensity case management in 11 studies involving patients with mental illness.

Risk of bias results

The risk of bias varied widely across the studies (Table 2; Appendix 5, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.140289/-/DC1). One study had a high risk of bias on 4 criteria, another had a high risk of bias on 3 criteria, 3 studies had a high risk of bias on 2 criteria, 18 had a high risk of bias on 1 criterion, and the rest of the studies did not have a high risk of bias on any of the criteria. The risk of bias was unclear across many of the criteria. Funnel plots did not reveal evidence of publication bias (data not shown).

Effect on emergency department visits

After a median duration of 9 months of follow-up, the proportion of patients who visited emergency departments did not differ significantly between the intervention and control groups (RR 1.11, 95% confidence interval [CI] 0.65 to 1.90; 6 studies; $I^2 = 0.85\%$) (Figure 2; Appendix 6, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.140289/-/DC1). The effect was significant only among older patients, with fewer in the intervention group than in the control group visiting emergency departments (RR 0.69, 95% CI 0.54 to 0.89; 2 studies; $I^2 = 0\%$).

In the analysis of studies that reported the mean number of emergency department visits per patient per month, no difference was found between the intervention and control groups after a median duration of 12 months of follow-up (mean difference −0.02, 95% CI −0.06 to 0.03; 7 studies; $I^2 = 0\%$) (Appendices 6 and 7, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.140289/-/DC1). None of the subgroup analyses was statistically significant.

Effect on hospital admissions

After a median duration of 12 months of follow-up, significantly fewer patients in the intervention group than in the control group were admitted to hospital (RR 0.81, 95% CI, 0.72 to 0.91; 18 studies; $I^2 = 58\%$) (Figure 3; Appendix 6). Specific quality improvement strategies that significantly reduced the number of admissions were case management, team changes, promotion of self-management and patient education. Among patients with chronic conditions other than mental illness, significantly fewer patients in the intervention group than in the control group were admitted to hospital. No difference was found between the intervention and control groups among patients with mental illness or severe mental illness (e.g., schizophrenia and severe bipolar disorder). Interventions that had a significant effect were those with an outreach component and those aimed at patients with the most frequent/severe utilization rate and those at risk of frequent use. Statistically significant results were not observed with interventions that used patient navigators or those aimed at patients with low utilization rates.

In the analysis of studies that reported the mean number of hospital admissions per patient per month, no difference was found between the inter-

vention and control groups after a median duration of 18 months of follow-up (mean difference 0.00, 95% CI –0.01 to 0.01; 12 studies; $I^2 = 0\%$) (Appendices 6 and 8, available at www.cmaj.ca/lookup /suppl/doi:10.1503/cmaj.140289/-/DC1). None of the subgroup analyses was statistically significant.

Table 1: Study and patient characteristics

Study*	Country	Quality improvement strategy	Patients with mental illness	Homeless patients	Age, yr, mean ± SD	Duration of follow up, mo
Botha et al., 2014[25] [61]	South Africa	CM, TC	Yes‡	Yes	32.3 ± 9.9	36
Burns et al., 2014[26]	United States	CM, SM, PE	No	No	NR	1
Gellis et al., 2014[27] [62]	United States	FR, CM, SM, PE, CE	Yes	No	79.2 ± 7.4	12
Ruchlewska et al., 2014[28]	Europe	SM	Yes‡	Yes	40.0 ± 11.6	18
Puschner et al., 2011[29]	Europe	TC, SM	Yes‡	Yes	41.3 ± 11.2	18
Courtney et al., 2009[30]	Australia	CM, TC, SM, PE	Yes	No	78.8 ± 6.9	6
Killaspy et al., 2009[31] [63]	Europe	CM, TC	Yes	No	39.0 ± 11.0	36
Koehler et al., 2009[32]	United States	TC, CM, PE, SM, CIS	No	No	78.5 ± 5.5	2
Bellon et al., 2008[33]	Europe	SM, CQI, CE	Yes§	No	48.4 ± NR	15
Lichtenberg et al., 2008[34]	Israel	CM, TC, SM	Yes	No	28.1 ± 11.0	12
Shumway et al., 2008[35]	United States	CM	Yes§	No	43.3 ± 9.5	24
Rivera et al., 2007[36]	United States	CM	Yes‡	Yes	38.3 ± 12.8	12
Schreuders et al., 2007[37] [64,65]	Europe	CM, SM	Yes	No	52.9 ± 14.8	3
Sledge et al., 2006[38]	United States	CM, TC, SM	No	No	51.0 ± 52.8	12
Scott et al., 2004[39] [66]	United States	TC, PE	No	No	74.2 ± 7.5	24
Castro et al., 2003[40]	United States	CM, PE, SM	No	No	36.4 ± 11.5	12
Laramee et al., 2003[41]	United States	CM, TC, PE, SM	No	No	70.7 ± 11.8	2
Harrison-Read et al., 2002[42]	Europe	CM, TC, SM	Yes‡	Yes	39.2 ± 39.2	24
Kasper et al., 2002[43]	United States	CM, TC, PE, SM, FI	No	No	61.9 ± 13.4	6
Katzelnick et al., 2000[44] [67]	United States	CM, PE, CE	Yes	No	45.5 ± NR	12
Burns 1999[45] [68–71]	Europe	CM, TC, PE	Yes‡	Yes	38.3 ± 11.7	24
Coleman et al., 1999[46]†	United States	CM	No	No	77.3 ± NR	24
Gagnon et al., 1999[47]	Canada	TC, SM, CE	No	No	81.6 ± 6.5	10
Salkever et al., 1999[48]	United States	CM	Yes‡	Yes	35.7 ± NR	18
Essock et al., 1998[49] [72]	United States	CM, TC	Yes‡	Yes	41.0 ± NR	18
Stewart et al., 1998[50]	Australia	TC, CM, PE, SM	No	No	75.0 ± 10.5	6
Beck et al., 1997[51]	United States	TC, PE, FR	No	NA	73.5 ± NR	12
Spillane et al., 1997[52]	United States	TC	No	No	38.5 ± 48.2	12
Lafave et al., 1996[53]	Canada	CM, TC, SM	Yes	No	35.8 ± 2.0	12
Quinlivan et al., 1995[54]	United States	CM	Yes‡	Yes	NR	24
Rich et al., 1995[55] [73]	United States	CM, TC, PE, SM	No	No	79.2 ± 6.0	3
Rosenheck et al., 1995[56] [74]	United States	CM, TC	Yes‡	Yes	NR	24
Muijen et al., 1994[57]	Europe	CM	Yes‡	Yes	37.0 ± 11.0	18
Rich et al., 1993[58]	United States	TC, CM, PE, SM	No	No	79.0 ± 6.2	3
Bond et al., 1988[59]	United States	CM	Yes	No	34.5 ± NR	6
Franklin et al., 1987[60]	United States	CM	Yes‡	Yes	NR	12

Note: CE = clinician education, CIS = clinical information system, CM = case management, CQI = continuous quality improvement, FI = financial incentives, FR = facilitated relay of clinical information, NR = not reported, PE = patient education, SD = standard deviation, SM = self-management, TC = team changes.
*Reference numbers in square brackets indicate companion reports.
†Cluster randomized clinical trial.
‡Included patients with severe mental health conditions, such as schizophrenia and substance abuse disorders.
§Mental illness was primary diagnosis, but patients may have had other comorbidities.

Table 2: Appraisal of risk of bias of the included studies*

Study	Random sequence generation	Allocation concealment	Similar baseline outcome measures	Similar baseline characteristics	Incomplete outcome data	Blinding	Contamination	Selective outcome reporting	Other bias
Botha et al.[25]	Low	Unclear	Low	Low	Low	Low	High	Unclear	Low
Burns et al.[26]	Unclear	Unclear	Low	Low	High	Low	Low	Unclear	Low
Gellis et al.[27]	Low	Unclear	Low	Low	High	Low	Low	Unclear	Low
Ruchlewska et al.[28]	Low	Unclear	Low	Low	Low	Low	Low	Low	Low
Puschner et al.[29]	Unclear	Low	Low	Low	High	Low	Low	Unclear	Low
Courtney et al.[30]	Low	Unclear	Low	Low	High	Low	Low	Unclear	Low
Killaspy et al.[31]	Low	Low	Low	Low	Low	Low	Low	Low	Low
Koehler et al.[32]	Low	Low	Unclear	Low	Unclear	Low	Low	Unclear	Low
Bellon et al.[33]	Low	Unclear	High	Low	High	Low	Low	Low	Unclear
Lichtenberg et al.[34]	Unclear	Unclear	Low	Low	Unclear	Low	Low	Unclear	Unclear
Shumway et al.[35]	Unclear	Unclear	Low	Low	High	Low	Low	Unclear	Low
Rivera et al.[36]	Unclear	Unclear	Unclear	Low	Low	Unclear	Low	Unclear	Low
Schreuders et al.[37]	Low	Low	Low	Low	High	Low	Low	Low	Low
Sledge et al.[38]	Unclear	Unclear	Low	Unclear	High	Low	Low	Unclear	Low
Scott et al.[39]	Low	Unclear	Low	Low	High	Low	Low	Unclear	Low
Castro et al.[40]	Unclear	Low	Low	Low	Low	Low	Low	Unclear	Low
Laramee et al.[41]	Low	Unclear	Low	Low	High	Low	Low	Unclear	Low
Harrison-Read et al.[42]	Low	Unclear	Low	Low	High	Low	Low	Unclear	Low
Kasper et al.[43]	Unclear	Unclear	Unclear	Low	Low	Low	Low	Unclear	Low
Katzelnick et al.[44]	Low	Low	Low	Low	High	Low	Low	Unclear	Unclear
Burns et al.[45]	Low	Low	Low	Low	Low	Low	Low	Low	Unclear
Coleman et al.[46]	Unclear	Unclear	Low	Low	High	Low	Low	Unclear	Low
Gagnon et al.[47]	Low	Low	Low	Low	Low	Low	Unclear	Unclear	Unclear
Salkever et al.[48]	Low	Low	Low	Low	High	High	Low	Unclear	Low
Essock et al.[49]	Unclear	Unclear	Unclear	High	Unclear	Low	Low	Unclear	Low
Stewart et al.[50]	Unclear	Unclear	Low	Low	Unclear	Low	Unclear	Low	Low
Beck et al.[51]	Low	High	Unclear	High	High	Low	Low	Unclear	Low
Spillane et al.[52]	Low	Low	Low	Low	High	Low	Low	Unclear	Unclear
Lafave et al.[53]	Unclear	Unclear	Unclear	Low	High	Low	Low	Unclear	Low
Quinlivan et al.[54]	Unclear	Unclear	Unclear	Low	Low	Low	Low	Unclear	Low
Rich et al.[55]	High	High	Unclear	High	High	Low	Low	Unclear	Low
Rosenheck et al.[56]	Low	Unclear	Low	Low	Unclear	Low	Low	Unclear	Unclear
Muijen et al.[57]	Unclear	Unclear	Low	Low	High	Unclear	Unclear	Unclear	Low
Rich et al.[58]	Low	Unclear	Unclear	Low	Low	Low	Low	Unclear	Low
Bond et al.[59]	Unclear	Unclear	Unclear	Unclear	High	Low	Low	Unclear	Low
Franklin et al.[60]	Low	High	Low	Low	High	Low	Low	Unclear	Low

Note: High = high risk, low = low risk, unclear = unclear risk.
*The risk of bias was assessed with the Cochrane risk-of-bias tool; only the main publications were assessed, not the companion reports.

Effect on clinic visits

After a median duration of 12 months of follow-up, the proportion of patients who made clinic visits did not differ significantly between the intervention and control groups (RR 0.86, 95% CI 0.58 to 1.27; 5 studies; I^2 = 91%) (Appendix 6). None of the subgroup analyses was statistically significant.

There was also no difference in the mean number of clinic visits per patient per month between the 2 groups after a median of 12 months of follow-up (mean difference −0.08, 95% CI −0.23 to 0.06; 11 studies; I^2 = 65%) (Appendices 6 and 9, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.140289/-/DC1). None of the subgroup analyses was statistically significant.

Effect on length of stay

After a median duration of 12 months of follow-up, the mean number of days in hospital per patient per month did not differ significantly between the intervention and control groups (mean difference −0.09, 95% CI −0.26 to 0.09; 19 studies; I^2 = 0%) (Appendices 6 and 10, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.140289/-/DC1). None of the subgroup analyses was statistically significant.

Interpretation

We found that quality improvement strategies focused on the coordination of care reduced hospital admissions among patients with chronic conditions other than mental illness and reduced emergency department visits among older patients. The strategies were not effective in reducing the use of health care services among patients with mental illness. This lack of effect may have been because 7 of the 11 studies involving patients with mental illness had a care coordination strategy (a form of case management) as part of their control intervention.

Of the interventions examined, team changes, case management and promotion of self-management had significant effects on reducing hospital admissions. Patient education, which is not one of the care-coordination quality improvement strategies based on Wagner's model,[16] also significantly reduced hospital admissions. Patient education and promotion of self-management are likely less resource intensive than case management interventions are,[17] which suggests that quality improvement strategies targeting patients (as opposed to clinicians) might be an efficient use of resources. Indeed, in other systematic reviews, patient education and promotion of self-management were found to be highly effective in improving diabetes care.[75,76]

A previous systematic review assessed the effect of various interventions on frequent users and found that case management and multidisciplinary teams were likely effective in reducing emergency department visits.[14] The authors did not conduct a meta-analysis or examine utilization beyond the emergency department. We observed statistically significant reductions in emergency department visits among older patients, but not specifically for interventions involving case management or team changes.

Limitations

We identified several limitations in the literature included in our analysis. First, similar to other studies of complex interventions,[77] studies included in our meta-analysis reported few details about the intensity and "dose" of quality im-
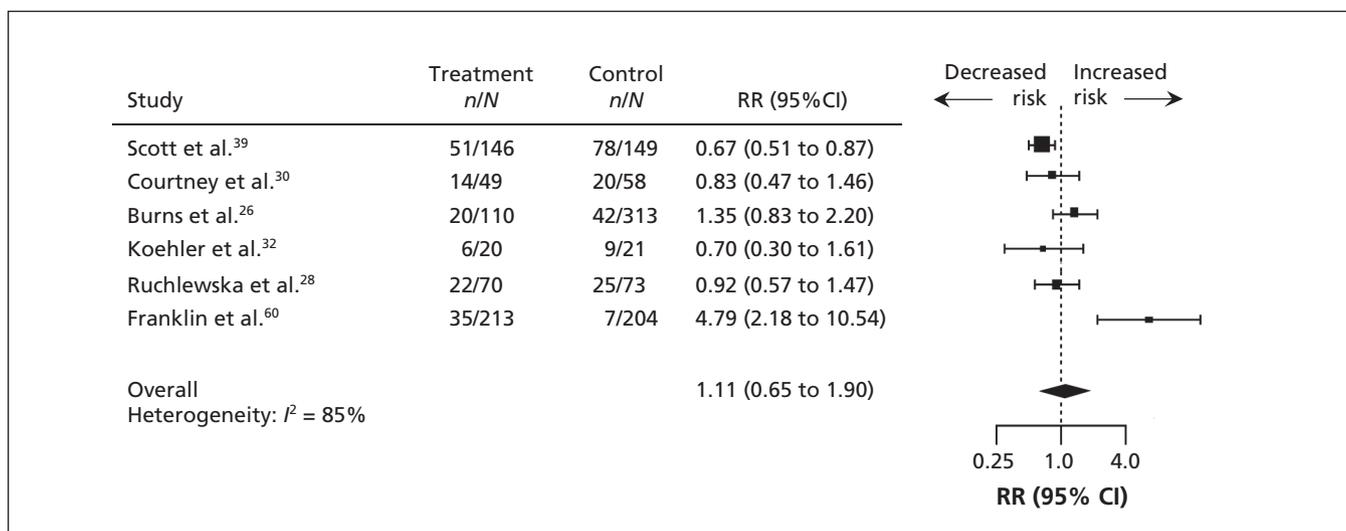

Figure 2: Effect of quality improvement strategies for coordination of care on emergency department visits. Relative risks less than 1.0 indicate a decreased risk of an emergency department visit. CI = confidence interval, RR = relative risk.
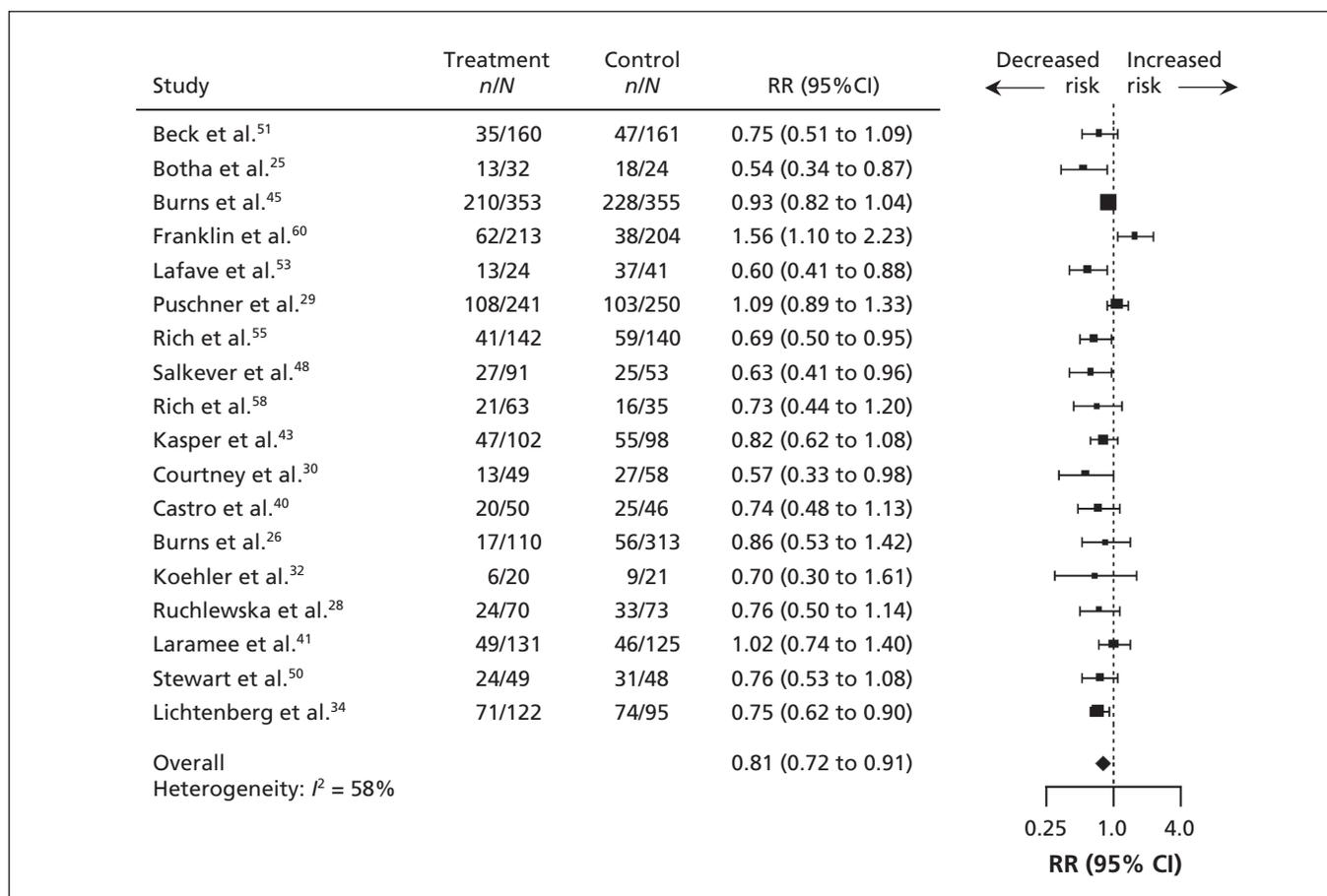
Study	Treatment n/N	Control n/N	RR (95%CI)
Beck et al.[51]	35/160	47/161	0.75 (0.51 to 1.09)
Botha et al.[25]	13/32	18/24	0.54 (0.34 to 0.87)
Burns et al.[45]	210/353	228/355	0.93 (0.82 to 1.04)
Franklin et al.[60]	62/213	38/204	1.56 (1.10 to 2.23)
Lafave et al.[53]	13/24	37/41	0.60 (0.41 to 0.88)
Puschner et al.[29]	108/241	103/250	1.09 (0.89 to 1.33)
Rich et al.[55]	41/142	59/140	0.69 (0.50 to 0.95)
Salkever et al.[48]	27/91	25/53	0.63 (0.41 to 0.96)
Rich et al.[58]	21/63	16/35	0.73 (0.44 to 1.20)
Kasper et al.[43]	47/102	55/98	0.82 (0.62 to 1.08)
Courtney et al.[30]	13/49	27/58	0.57 (0.33 to 0.98)
Castro et al.[40]	20/50	25/46	0.74 (0.48 to 1.13)
Burns et al.[26]	17/110	56/313	0.86 (0.53 to 1.42)
Koehler et al.[32]	6/20	9/21	0.70 (0.30 to 1.61)
Ruchlewska et al.[28]	24/70	33/73	0.76 (0.50 to 1.14)
Laramee et al.[41]	49/131	46/125	1.02 (0.74 to 1.40)
Stewart et al.[50]	24/49	31/48	0.76 (0.53 to 1.08)
Lichtenberg et al.[34]	71/122	74/95	0.75 (0.62 to 0.90)
Overall Heterogeneity: I^2 = 58%			0.81 (0.72 to 0.91)

Figure 3: Effect of quality improvement strategies for coordination of care on hospital admissions. Relative risks less than 1.0 indicate a decreased risk of admission to hospital. CI = confidence interval, RR = relative risk.

provement strategies, as well as further details regarding delivery. The Standards for Quality Improvement Reporting Excellence (SQUIRE) guidelines have been developed to improve the reporting of quality improvement strategies,[78] which will be of benefit to future meta-analyses such as ours. Second, in some studies, the duration of intervention may have been too short (e.g., 1 mo) to show any significant impact. Third, the duration of follow-up (as little as 3 mo) was also short in some studies. Fourth, the definition of a frequent user was inconsistent across the studies. Finally, most of the included studies had unclear or inadequate concealment of the allocation sequence and a high risk of bias owing to incomplete outcome data.

Our systematic review process also had some limitations. First, although we searched for unpublished studies, none was identified. However, the funnel plots compiled for the meta-analyses of more than 10 RCTs showed no evidence of publication bias.

Second, this was a challenging area to search, and many of the included studies did not use adequate search terms to allow their identification. We conducted supplementary searches to surmount this issue (e.g., forward citation searches, manual searches of related articles), but we may have missed relevant studies.

Third, our analysis was limited because the quality improvement strategies were complex and difficult to classify consistently. For example, some of the strategies were interconnected, such as patient education and promotion of self-management, or case management and team changes. However, we conducted a sensitivity analysis of our classification of the strategies, and our results did not change.

Fourth, because of the dearth of data, we were unable to perform more sophisticated analyses, such as meta-regression analysis. As such, we did not control for all potential confounding factors or effect modifiers. Also, there was a small number of studies included for some outcomes (e.g., emergency department visits, clinic visits), which may have led to the nonsignificant effect. As well, the results of the subgroup analyses should be interpreted with caution because of the risk of type 2 statistical error owing to the small number of studies included.

Fifth, many of the meta-analyses had substantial heterogeneity, which was to be expected given the number of quality improvement strategies assessed, the variety of patient populations examined and the inconsistent definitions of usual care used across the studies. The high heterogeneity may indicate that the results should be interpreted with caution; however, heterogeneity was substantially lower in most of the subgroup analyses (e.g., by type of quality improvement strategy).

Sixth, we did not examine patient-centred outcomes, such as patient experience and quality of life, because the target for our research was health system outcomes.

Seventh, we were unable to examine contextual factors that would have been relevant to our objective, such as socioeconomic status, appropriateness of care and access to a primary care physician, because they were not measured consistently across the studies.

Finally, we abstracted some data on costs but were unable to summarize this in a meaningful manner, because this information varied widely by context.

Conclusion

We found that quality improvement strategies focused on the coordination of care reduced hospital admissions among patients with chronic conditions other than mental illness and reduced emergency department visits among older patients. Novel strategies are required for patients with mental health conditions. Researchers who are developing and implementing interventions targeted to frequent users should consider specific strategies, such as team changes, case management and promotion of self-management, because these approaches appear to be more effective than other quality improvement strategies in reducing health care utilization. Further research is needed to determine how to optimize care coordination strategies for specific patient subgroups and settings.

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