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The Effectiveness of Emergency Department Visit Reduction Programs: A Systematic Review

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Study objective: Previous reviews of emergency department (ED) visit reduction programs have not required that studies meet a minimum quality level and have therefore included low-quality studies in forming conclusions about the benefits of these programs. We conduct a systematic review of ED visit reduction programs after judging the quality of the research. We aim to determine whether these programs are effective in reducing ED visits and whether they result in adverse events.

Methods: We identified studies of ED visit reduction programs conducted in the United States and targeted toward adult patients from January 1, 2003, to December 31, 2014. We evaluated study quality according to the Grading of Recommendations Assessment, Development, and Evaluation criteria and included moderate- to high-quality studies in our review. We categorized interventions according to whether they targeted high-risk or low-acuity populations.

Results: We evaluated the quality of 38 studies and found 13 to be of moderate or high quality. Within these 13 studies, only case management consistently reduced ED use. Studies of ED copayments had mixed results. We did not find evidence for any increase in adverse events (hospitalization rates or mortality) from the interventions in either high-risk or low-acuity populations.

Conclusion: High-quality, peer-reviewed evidence about ED visit reduction programs is limited. For most program types, we were unable to draw definitive conclusions about effectiveness. Future ED visit reduction programs should be regarded as demonstrations in need of rigorous evaluation. [Ann Emerg Med. 2016;68:467-483.]

Please see page 468 for the Editor's Capsule Summary of this article.

A **podcast** for this article is available at www.annemergmed.com.

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INTRODUCTION

Despite some evidence to the contrary,[1] many policymakers, health care providers, and other stakeholders believe a substantial number of emergency department (ED) visits could be avoided or conducted in less costly alternative settings.[2] Payers have tried various means to discourage the use of EDs and to encourage the use of non-ED settings, such as primary care and retail clinics, in accordance with a belief that this will result in health care savings.[3]

Nationwide, there are many programs to reduce ED visits.[4,5] Some deploy intensive management to address social and medical needs for a small group of high-risk individuals who contribute to a large number of ED encounters. Others aim to decrease ED use broadly across a large population with low-acuity visits. ED visits are often perceived as costly and unnecessary, increasing pressure from payers such as Medicaid to reduce them.[6,7]

The effectiveness of these programs is poorly understood. There have been 4 published reviews that have focused on a specific program type or target population (eg, frequent ED users, case management programs). Each review concluded that the majority of programs reduced ED use. However, none applied a quality assessment in advance to determine which studies to include. As a result, the published systematic reviews include low-quality studies, which could undermine the validity of conclusions about program effectiveness. In addition, none included research published after 2010.[8-11] It is possible that including research studies conducted since 2010 and restricting the review to moderate- and high-quality studies would lead to different conclusions.

Attempts to reduce ED use may be logically sound, but it is unclear whether strategies to pursue ED visit reduction are effective and without adverse consequences. We conducted a systematic review of published moderate- and

Editor's Capsule Summary

What is already known on this topic

Many different interventions have been tested to reduce emergency department (ED) utilization among frequent or low-acuity users, with mixed results.

What question this study addressed

The authors reviewed the effectiveness of ED reduction programs but limited their evaluation to studies of moderate to high quality.

What this study adds to our knowledge

Less than one third of ED reduction programs were moderate to high quality. A diverse set of interventions and patient populations was examined. Only case management was found to reduce frequent ED use, and this evidence was based on 3 small studies.

How this is relevant to clinical practice

High-quality studies on this topic are needed; there is no need for more poorly conducted studies.

high-quality peer-reviewed studies of ED visit reduction programs between 2003 and 2015 that sought to reduce adult ED visits in the United States. The objective of our systematic review was to determine whether specific types of ED visit reduction programs are effective in reducing ED visits and result in adverse events. Our assessment was limited to those studies we judged to be of moderate or high quality by Grading of Recommendations Assessment, Development, and Evaluation (GRADE) criteria.

MATERIALS AND METHODS

We report our systematic review according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.[12] We submitted our formal review protocol to PROSPERO, including search strategy, primary outcomes, and study inclusion and exclusion criteria.

Study Design

We conducted a systematic literature search of PubMed, CINAHL, and PsycINFO for studies published between 2003 and 2014. Our search strategy included 1 main search term, "ED use." For this search term, we combined the Medical Subject Headings terms "emergency service, hospitalization/utilization," (CINAHL) "emergency service/utilization," "emergency care/utilization," and "emergency medical services," and (PsycINFO) "emergency medical services, hospital, and utilization." Using the Boolean "and" operator, we combined these subject heading terms with search terms related to "high frequency or high risk" and then with terms related to "low acuity." We then combined these results with terms that reference programs designed to reduce visits. Finally, we performed supplemental searches with terms used in previous reviews, related to programs or interventions designed to reduce ED utilization (Table 1).

We focused on studies published from 2003 to 2014 because during this period, rapid increases in ED utilization motivated an increasing number of interventions to decrease ED use, and because studies conducted in this period are relevant for practice today. We did not consider gray literature for this review after our initial scan demonstrated it did not meet the quality criteria outlined below.

Data Collection and Processing

We limited the scope of our review to studies of programs with a stated intent to reduce ED visits, which had ED visit reduction as a prespecified study outcome. We included randomized controlled trials and observational studies of programs published in the peer-reviewed literature that reported changes in ED visits as a discrete outcome. We included studies only from the United States because results from other countries may not be comparable because of differences in health care delivery and payment systems. We targeted studies that included adults either exclusively or in combination with children and excluded those that focused only on children. We excluded studies that reported ED use only as an aggregate outcome in combination with other health services use, did not include an abstract, and were not written in English. We included programs that focused on visits to medical EDs for mental health complaints but excluded those that focused exclusively on visits to psychiatric EDs because the patients who visit them and the care they deliver are distinct from those of nonpsychiatric EDs.

We decided a priori that several types of delivery system interventions whose primary purpose was not to reduce ED utilization were out of this review's scope. This included chronic disease management programs whose primary goal was to avoid hospital readmissions, patient-centered medical homes, electronic medical records, and clinical treatment studies (unless such studies were directly related to ED management and designed to reduce ED visits). Although we did include ED visit reduction programs whose target population included active substance users, we excluded studies of programs in which the primary goal was substance

Table 1. ED visit reduction program studies: search strategy and terms.

Main Search Theme	Terms Searched
Primary search	
ED use	(PubMed) Medical Subject Headings term "Emergency service, hospitalization/utilization," (CINAHL) "Emergency Service/utilization," "Emergency Care/utilization," and "Emergency Medical Services," and (PsycINFO) "emergency medical services, hospital, and utilization"
Secondary search	
High frequency/high risk	"frequent use" "frequent flyer" "high risk" "high use" "frequent attendee" "heavy use" "repeater" "recidivist" "revolving door" "repeat visits" "repeated visits"
Low acuity	"non-urgent" "non-emergent" "non-emergency" "overuse" "low acuity" "misuse" "inappropriate use" "ambulatory care sensitive" "avoidable" "preventable"
Terms that reference programs or interventions designed to reduce visits	"intervention" "program" "protocol" "initiative" "project" "reduction" "reduce*" "decrease*" "decline*" "cut back" "lessen" "eliminate*"
Terms specific to program types	ED diversion: "diversion" "triage" "call lines"
	Patient education: "patient education" as subject heading
	Alternative site expansion: "extended hours" "after hours" "clinic expansion" "mobile clinic" "same-day appointment" "next-day appointment" "urgent care clinic" "added sites" "additional sites" "new sites" "new clinics" "urgent care" "retail clinic" retail care"
	Linkages to primary care/care coordination: "care coordination" "care integration" "primary care access" "primary care referral" "primary care follow-up" "primary care appointment"
	Health technology: "electronic health record" "electronic medical record" "health information technology" "data sharing" "electronic information sharing"
	Financial incentives: "cost-sharing" "cost share" "co-pay" "co-payment" "managed care" "bundled payment" "out-of-pocket" "shared saving"
	Case management: "case management" "brokerage" "social worker" "case worker" "case manager" "case coordinator" "case coordination"
	Health/social service navigation/care coordination: "navigator" "navigation"
	Pain management: "pain management" "pain control" "chronic pain" "opioid seeking" "opiate seeking" "opioid prescription" "opiate prescription" "opiate prescribing" "opioid prescribing" "fraud" "opioid dependence"
	Ambulatory ICUs: "ambulatory intensive care" "outpatient intensive care" "outpatient observation unit"

use treatment and not ED visit reduction. Similarly, we excluded criminal justice system diversion programs because the primary goal of such programs is diversion out of the criminal justice system, not ED visit reduction. We excluded programs that focused on transitions of care from hospital to home because such programs have avoidance of hospital readmissions as their primary goal. We considered programs that focused on nonmedical issues associated with ED use and hospitalizations, such as permanent supportive housing and medical respite care for homeless individuals, outside of our scope.

One primary reviewer (M.J.K.) screened study titles for inclusion and exclusion criteria (Figure E1, available online at http://www.annemergmed.com). After the title screen, we selected a 10% random sample of abstracts, and 2 reviewers (M.J.K. and J.P.) screened abstracts for potential inclusion (Figure E1, available online at http://www.annemergmed.com). Once we confirmed satisfactory interrater reliability ($\kappa>0.7$), the primary reviewer (M.J.K.) screened the remaining abstracts to select articles for further evaluation. We followed a similar process with the selected articles. Two reviewers (M.J.K. and JP) screened a 20% random sample of the selected full articles (n=159) (Figure E1, available online at http://www.annemergmed.com), and after we confirmed satisfactory interrater reliability ($\kappa>0.7$), the primary reviewer (M.J.K.) appraised the remaining potentially eligible articles for inclusion.

From all eligible studies, we extracted program title; geographic location; intervention type; target population; study design and methods; participant enrollment; program setting, including whether studies occurred at a single site or multiple (>1) sites; program duration; effect on ED use; effect on non-ED health care use; and financial data related to program costs and savings.

We classified studies into one of 2 distinct categories: those directed at high-risk populations and those directed at low-acuity visits. High-risk programs aimed to reduce ED use in high-risk populations including individuals who were frequent users of ED services or who possessed characteristics of those who were likely to become frequent users of ED services. Low-acuity programs aimed to reduce "low-acuity" ED visits that were not "emergency" in nature and could in theory be managed safely in a non-ED setting.

Within these 2 categories, we separated studies into multiple program subtypes. We based the subtypes on an existing taxonomy proposed by Morgan et al[9] and created additional program subtypes when studies of programs did not fit into that framework. We identified 7 subtypes

related to high-risk populations and 3 related to low-acuity ED visits (Figure 1).

After data collection, we used the GRADE criteria system to rate the quality of individual studies of ED visit reduction programs.[13] We restricted our analysis to studies we rated as either moderate or high quality according to GRADE. Two reviewers (M.J.K. and J.P.) examined each eligible study for quality grading (Figure E1, available online at http://www.annemergmed.com). We assessed the methodological quality of studies independently from the study findings and included studies with both positive findings (evidence for ED visit reductions) and negative ones (no evidence for ED visit reductions, or evidence for increases in ED visit rates). Under the GRADE system, studies are assigned an initial 4-point scale ranging from very low to high quality according to study design (Figure 2). We assigned an initial high rating to randomized controlled trials and an initial rating of moderate to studies with a nonrandomized but equivalent comparison group, in which there would be limited systematic bias in selection for the intervention group; and quasi-experimental studies with a nonequivalent comparison group, with rigorous statistical methods applied to adjust for confounding between groups. We assigned an initial rating of low to all other study types. After the initial rating assignment, we divided studies into 2 sets: initial high- or moderate-quality and initial low-quality studies. For each set, 2 reviewers evaluated each study according to 3 criteria that could result in a quality rating downgrade (with "very low" as the lowest possible grade) and 3 criteria that could result in an upgrade (to a maximum of "high"). Criteria used to downgrade evidence were risk of bias or study limitations, imprecision, and publication bias. The indicators for rating evidence upward were having a large magnitude of effect, having a dose-response gradient, and having plausible unobserved confounders that would minimize the observed effect, therefore making it likely that the magnitude of effect could be larger than reported (see Table E1, available online at http://www.annemergmed.com, for additional details). We compared ratings between reviewers (M.J.K. and J.P.) to assess interrater reliability ($\kappa>0.7$). We considered the 2 initial reviewers to have reached consensus if their GRADE scores matched (eg, moderate and moderate, low and low). In instances of disagreement, a third reviewer (M.C.R.) also assigned a rating and then convened a meeting of all 3 reviewers to achieve consensus.

Primary Data Analysis

We describe studies we excluded in Table E2, available online at http://www.annemergmed.com. The small number of moderate- or high-quality studies included in our review had a high level of heterogeneity in terms of program type and outcomes reporting, which limited our ability to conduct a meta-analysis. Instead, we created evidence tables to display study characteristics and results, organized first by program category (high risk versus low acuity) and then by program subtype (Figure 1). We analyzed studies within each program subtype to compare intervention characteristics, study methods, and outcomes. We used GRADE ratings to develop recommendations about the overall quality of the evidence for each program subtype.

Outcome Measures

Our primary outcome of interest was ED utilization. Secondary outcomes included adverse events, defined as hospital admissions and mortality. We defined adverse events as increases in hospital admissions or mortality because ED visit reduction programs could have resulted in increased hospital admissions or mortality if, by discouraging ED use, they caused individuals to delay seeking treatment. We had planned to examine the cost-effectiveness of the programs in our review, but there were insufficient data to evaluate it.

RESULTS

We evaluated the quality of 38 studies of ED visit reduction programs (Table 2). Of the 38 studies, we rated 13 as moderate to high quality according to GRADE criteria and included them in this review; 4 were evaluations of programs targeted toward high-risk populations and 9 targeted low-acuity visits (Tables 3 and 4). We assigned low or very low quality ratings to the 25 studies[14-38] excluded from our review (Table E2, available online at http://www.annemergmed.com) for combinations of the following reasons: lack of a comparison group (18 studies); surveillance of outcomes at only a single site (14 studies); insufficient statistical testing (6 studies); small sample size, ranging from 10 to 26 participants (5 studies); use of a nonequivalent comparison group (5 studies); and outcomes based on short or different follow-up periods between intervention and comparison groups (3 studies).

There were 3 studies that evaluated the effect of case management for high-risk patients with frequent use of the ED.[39-41] The interventions targeted people with at least 5 ED visits in the past year[39,41] or fewer than 5 ED visits combined with multiple hospital admissions in the past year.[40] In all 3 interventions, case managers provided intensive direct services within the ED, hospital, and community by frequent, in-person contact with patients. All 3 studies showed a statistically significant reduction in ED visits. One study reported consistently fewer ED visits

High Risk Program Types

Case management: These programs employ case managers to assess a patient's unmet needs and to assist him/her by delivering care or by communicating and coordinating with health and/or social service agencies. Case managers can be unlicensed (community health workers, care coordinators) or can be social workers or RNs. Case management programs have higher staff/client ratios and a higher degree of staff training than other less intensive models that aim to coordinate care or provide basic services navigation to patients.

Navigation and care coordination: Programs are designed to assist patients in making connections to primary care, other medical providers or services, and/or social service agencies and resources. These programs differ from case management programs based on the intensity of assistance provided and the model of care delivery.

Acute disease management and education: Programs target individuals who have severe relapsing and remitting conditions, such as asthma, sickle cell disease, or alcohol addiction, which can lead to repeated use of the ED. These programs aim to educate patients about self-management and alternative sites of care, and provide strategies to recognize and prevent exacerbations and avoid disease triggers.

Chronic non-cancer pain management: Programs involve switching participants to non-opioid treatment regimens provided in the ED, and care coordination with primary care providers to reinforce use of non-opioid treatments.

Health technology and information sharing: Programs use electronic medical records (EMR) to identify frequent ED users. Multidisciplinary care teams develop individualized care plans for each frequent utilizer, and the care plans are uploaded into the EMR and available to treating providers upon repeat visits. The teams update care plans on a regular basis.

Patient education: This program type includes broadly implemented patient educational programs providing instruction about appropriate use of the ED either in general, or for specific conditions.

Ambulatory Intensive Care Units (AICUs): AICUs deliver care similar to intensive case management programs in terms of high-risk patient selection and deployment of a multidisciplinary team to address patient needs in multiple health and social domains. Yet while case management programs tend to use a social model of care, AICUs function on a medical model, with nurses at the center, focusing on optimizing medical treatment.

Low Acuity Visit Program Types

Primary care linkage: Programs are aimed at reducing low acuity ED use by strengthening linkages to primary care and/or providing care coordination. These efforts are typically conducted in the ED during a visit, or shortly after an ED visit.

ED Diversion: Programs aim to direct patients with away from the ED, either before or at the time of ED triage. These programs can occur by directing ED patients to onsite urgent or primary care clinics, or can occur during an encounter with EMS prior to ED arrival.

Financial penalties/cost-sharing: Programs involve alterations in co-payments for ED visits and other healthcare services.

Figure 1. Program type descriptions.

High quality—Further research is very unlikely to change our confidence in the estimate of effect

Moderate quality— Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate

Low quality— Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate

Very low quality— Any estimate of effect is very uncertain.

Figure 2. GRADE quality rating criteria.

among intervention patients in each 6-month period after enrollment, up to 24 months.[39] The second reported a 32% lower risk of ED visits during 1 year compared with that for controls,[40] and the third reported 12.1 fewer ED visits during 6 months compared with that for prospective controls and 12.8 fewer ED visits during 6 months compared with that for historical controls.[41] None of the studies found an increase hospital admission rates beyond what would have been expected. The single study that examined mortality differences found higher rates of death among nonparticipants (zero in the intervention group, 2 in the prospective control group, and 7 in the historical control group).[41]

One randomized controlled trial assigned adult and pediatric patients 1:1 to usual care or a comprehensive asthma education program intervention.[42] To be eligible, participants were required to have a diagnosis of moderate to severe asthma and to have had at least 1 ED visit in the previous year. The intervention consisted of a telephone call from an asthma nurse educator 3 to 5 days after the ED visit, who arranged and attended a primary care provider follow-up visit and created an asthma care plan for the patient. This nurse conducted a home visit 6 weeks later to evaluate environmental triggers and to review the care plan. Authors found a nonsignificant reduction in ED visits at 6-month follow-up in the intervention group compared with controls (23.1% versus 31.1%) and did not assess hospitalizations or mortality in the intervention or control groups.

Table 2. ED visit reduction program details.

Program Type	No. Programs Reviewed	GRADE Rating	
		High/ Moderate	Low/ Very Low
Case management	8	3	5
Navigation and care coordination	2	0	2
Acute disease management and education	4	1	3
Chronic noncancer pain management	3	0	3
Health technology and information sharing	2	0	2
Patient education	1	0	1
Ambulatory ICUs	1	0	1
Total	21	4	17
Linkage to primary care/care coordination	9	3	6
ED diversion	1	1	0
Financial penalties/cost sharing	7	5	2
Total	17	9	8

We found 3 randomized controlled trials of programs for patients with low-acuity complaints that involved linkage to primary care physicians at or close to ED discharge.[43-45] Each study targeted different patient populations. One study found evidence for reductions and 2 others did not. One study randomized[43] health plan members with an ED discharge diagnosis of a primary anxiety disorder 1:1 to a telephone-based intervention. Investigators reported statistically significant reductions at 6 months for ED visits with psychiatric diagnoses, comparing intervention participants to controls (0.26 visits versus 0.39 visits, respectively), and did not examine hospital admission rates or mortality.

The second randomized controlled trial targeted ED patients aged 65 years and older who were expected to be discharged from the ED. Patients randomized to the intervention met with a geriatric nurse, who conducted a needs assessment during the ED visit, sent a summary to the patient's primary care provider, and conducted telephone follow-up to encourage the primary care provider visit. Investigators found no difference in the percentage of participants who made repeated ED visits within 120 days compared with controls (37% versus 40%) and found no differences in hospitalizations (28% versus 27%).[44] The study did not evaluate mortality.

A third randomized controlled trial targeted uninsured patients with no primary care provider. Patients were randomized 1:1 during an ED visit, and investigators evaluated the effect of using ED-based health promotion "advocates" to help patients choose a primary care provider during the visit and then faxed the patients' information to the chosen primary care provider. Advocates contacted patients after the visit in person or over the telephone to

Table 3. ED visit reduction program studies: outcomes and results.

Source	Study Design	Program Type	ED Visits	Hospitalizations	Mortality
Shumway et al[39] (2008)	RCT	Case management	↓	↔	NR
Shah et al[40] (2011)	NCBA	Case management	↓	↔	NR
McCormack et al[41] (2013)	NCBA	Case management	↓	NR	↓
Horwitz et al[45] (2005)	RCT	Navigation and care coordination	↔	↔	NR
Brown et al[42] (2006)	RCT	Acute disease management and education	↔	↔	NR
Mion et al[44] (2003)	RCT	Linkage to primary care and care coordination	↔	↔	NR
Kolbasovsky et al[43] (2007)	RCT	Linkage to primary care and care coordination	↓	NR	NR
Doran et al[46] (2013)	CBA	ED diversion	↔	NR	NR
Lowe et al[49] (2010)	NCBA	Financial penalties	↓	↓	NR
Wallace et al[50] (2008)	NCBA	Financial penalties	↓	↓	NR
Mortensen et al[51] (2010)	NCBA	Financial penalties	↔	NR	NR
Hsu et al[47] (2006)	NCBA	Financial penalties	↓	↓	↔
DeVries et al[48] (2013)	NCBA	Financial penalties	↔	NR	NR

RCT, Randomized controlled trial; ↔, no significant difference between groups (or between pre- and postintervention); *NR*, not reported; *NCBA*, noncontrolled before and after; *CBA*, controlled before and after.

help schedule a primary care provider appointment and to connect patients to other community-based services. Study investigators followed patients for 6 months after enrollment. Investigators comparing intervention and control groups found no difference in the probability of an ED visit (relative risk 1.07; 95% confidence interval 0.72 to 1.58) or hospitalization (relatve risk 0.39; 95% confidence interval 0.10 to 1.46) and did not assess mortality.[45]

One quasi-experimental trial examined a post-ED triage diversion program for ED patients with low-acuity complaints. Investigators referred eligible patients to an onsite primary care clinic (intervention) or to an ED-based urgent care clinic (usual care) according to which site (urgent care versus onsite primary care) would result in the least delay.[46] A secondary comparison group included ED patients who met eligibility criteria but who had a primary care provider outside the study hospital. The study found no reductions in ED visits at 12-month follow-up comparing intervention to usual care groups (adjusted mean difference –0.23; 95% confidence interval –0.61 to 0.16) and did not assess hospitalization rates or mortality.[46]

Five studies examined the effect that imposing ED copayments at the visit had on ED use. The largest study examined the effect of ED copayments for Kaiser Permanente members with Medicare or commercial insurance.[47] Another study evaluated a program for individuals enrolled in commercial insurance through their employer.[48] Three studies were of copayments implemented by state Medicaid programs.[49-51]

Three of the 5 studies—1 within Kaiser and 2 studies of copayments implemented within the Oregon state Medicaid program—reported significant reductions in ED visits. The Kaiser study found that ED visit rates decreased with increasing copayment levels (adjusted relative rate $1 to $5: 0.962 [95% CI 0.955-0.970] up to $50 to $100: 0.765 [95% CI 0.756-0.774]). The 2 studies of $50 ED copayments within Oregon Medicaid (which also implemented $5 copayments for primary care visits and $250 copayments for hospital admissions) found ED visit reductions of 18.0% and 7.9%,[50] respectively.[49] The 2 additional studies found no difference when comparing intervention and control groups.

Three studies examined programs' effect on hospitalizations. The Kaiser study found significant decreases for commercially insured subgroups (4% for $20 to $35 copayments; 10% for $50 to $100 copayments) and no difference among Medicare beneficiaries. One of the 2 Oregon Medicaid studies[50] examined inpatient hospital admissions and found they were significantly decreased, by 27.3%, whereas the other found that ED-based hospital admissions were reduced by 24.0%.[49] The remaining 2 studies did not evaluate program effect on inpatient hospital admissions. The study within Kaiser was the only one to evaluate mortality and found no difference in relative mortality rates among Kaiser members with and without copayments.

LIMITATIONS

Our study has several limitations. Program terminology varied widely across the studies included in our review. Terms such as "low-acuity" or "frequent ED user" were defined differently across studies. We grouped studies that used similar definitions into similar program types and subtypes to minimize these differences. We found variations in how target populations were identified, how programs were staffed, how outcomes were measured, and how programs defined success or failure. This lack of

Table 4. Descriptions and characteristics for studies of ED visit reduction programs, rated moderate to high.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
High-risk programs															
Case management															
Shumway, 2008	Presented to ED, ≥5 previous visits, identified psychosocial targets for case management	Recruited from single study ED, randomized two thirds to intervention, (I), N=167	(UC): N=85	RCT, stratified by no. of ED visits in past year: 5–11 visits vs ≥12 visits (within-individual fixed effects, nested within treatment arm fixed effects)	1997–1999	San Francisco, CA, San Francisco General Hospital	(I) Psychiatric social workers w/master's: intensive social and medical case management (crisis intervention, supportive therapy, housing and benefits assistance, coordination with medical/mental/substance abuse services, home visits and community tracking) CM:client ratio 1:15; (UC)?	12 mo preenrollment, 24 mo postenrollment, divided into 6-mo periods	Mean ED visits per 6-mo period (single hospital records)	Decreasing ED visits over time: (I) vs (UC) declining time trend ($P<.01$); no differences in effect of (I) by no. of ED visits before enrollment	Medical, psychiatric admissions, outpatient visits, psychosocial outcomes	No signif. diff. in admissions, outpatient visits, (I) vs (C) improved psychosocial outcomes	Cost of medical and psychiatric services: episode charges X Medicare cost-to-charge ratio; cost of physicians' professional services: local Medicare physician fee schedule; ambulance costs: average ambulance charge X Medicare cost-to-charge ratio (single hospital charges)	ED costs lower: (I) vs (C), $P<.01$; no signif. diff. medical/psychiatric costs, or total hospital costs	Moderate
Shah, 2011	Frequent users (≥4 ED visits/≥3 admissions/≥2 admissions+1 ED visit in past year), <200% FPL, enrolled in low-income health plan	Identified through health plan use data, recruited by telephone to participate, active in program ≥90 days, (I): N=98	Frequent user nonparticipants, (UC): N=160	Pre/post non-equivalent comparison groups, multivariate regression to adjust for potential confounders	2008–2010	Kern County, CA, Kern Medical Center	Care managers: ≥1 visit/mo home/clinic/resource centers. Activities include development of care plan, schedule appointments, follow-up on referrals, help w/ medication refills, attend appointments and hospitalizations to assist with advocacy, communication with providers and education on follow-up/discharge instructions,	1 y preenrollment and 90 days to 1 y postenrollment	Number of ED visits (single hospital records)	Lower risk of ED visits: (I) vs (UC): adjusted IRR −0.39, ($P<.001$); median number of ED visits decreased in (I) −3.9 but not directly compared to changes in (UC) group	Change in hospitalizations (hospital medical records)	No signif. diff. in hospitalization; IRR −0.21 ($P=.38$)	Costs, measured as medical center expenditures for ED and hospital inpatient services of single medical center, per patient per year (excluded: pharmacy, costs outside of single hospital, and costs of program)	Unadjusted ED costs per patient per year decreased: (I) only: $2,545 to $1,874; unadjusted inpatient admissions mean costs per year decreased: (I) only: $20,298–$7,053, no comparison to UC group.	Moderate

									help with arranging social support services, eg, housing and transportation. Establish primary care medical home.								
McCormack 2013	5 ED visits annually for 2 consecutive years and 1 within 6 mo, had alcohol dependence, and had been undomiciled without shelter use for 9 of 24 mo	Identified from ED visit records at study ED and recruited during a visit to the study ED	Patients recruited prospectively from the same pool but who received standard care and patients identified retrospectively from the previous year, using the same algorithm for patient identification, and who were alive for the entire observation period	Prospective, nonequivalent, pretest-posttest, control group trial	2011–2012	New York City, Bellevue Hospital	ED social worker to approached patients on first visit. On a subsequent visit, homeless outreach team came to ED to confirm eligibility and complete enrollment. On each subsequent visit, social worker and outreach team met with participants according to care plans, offered shelter on discharge. Assigned case workers relocated participants into increasingly supportive housing settings and coordinated care.	6 mo pre- and postintervention	Difference in differences in number of ED visits, using the 2 nonequivalent control groups	Decreased number of ED visits: 12.1 fewer compared with prospective controls and 12.8 fewer compared with retrospective controls	Differences in hospital days, homeless status, and mortality 6 mo after enrollment	8.5–19.1 fewer inpatient days. Eighteen participants accepted shelter; no control individuals were housed. No deaths occurred in the intervention group. Two prospective and 7 retrospective control individuals died and were excluded from the visit analysis.	Not measured	Moderate
Acute disease management and education																	
Asthma																	
Brown, 2006	Adults and children w/ moderate to severe asthma, presented to ED at least once in past year	Recruited in study ED, (I): N=117	(UC): N=122	RCT, stratified adults vs children	2004–2005	Grand Rapids, MI, ED based at community hospital	(I): Asthma nurse-educator: telephone contact 3–5 days post-ED visit, arranged and attended follow-up w/ PCP, assisted w/treatment review, asthma care plan; home visit 6 wk post-ED discharge, medication and plan review, eval. environmental	6 mo postintervention	Time to first relapse: ED/urgent PCP visit for asthma (self-report)	No signif. diff. in time to first relapse: (I) vs (UC) HR=0.79 (95% CI 0.48–1.29); No signif. diff. when stratified by adults/children	Total hospitalizations for asthma, missed days of work/school, asthma self-care measures (self-report)	No signif. diff. in total number of hospitalizations, missed days, self-care measures, except slight improvement in actions to reduce triggers in (I)	Not studied	Moderate

Table 4. Continued.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
							triggers; (UC): education on inhaler, PF meter, discharge instructions and referral if needed								
Low-acuity programs															
Linkage to primary care and care coordination															
Mion, 2003	Elderly (≥65 y) presented to ED and expected discharge from ED	Recruited from 1 of 2 study EDs, randomized to (I): N=326	Randomized to (UC): N=324	RCT, stratified by high/low risk (nurse triage), block randomization, intention-to-treat analysis	Not stated	Not stated, (Cleveland Clinic and Case Western), single ED	(I): Geriatric nurse: comprehensive geriatric assessment to identify unmet needs (medical, social, health care) and caregiver abilities, collaborate w/ medical team for discharge plan, referral for home care services, discharge summaries sent to PCP; short-term telephone follow-up with participant until connection made in the community; (UC): written discharge recommendations for follow-up	30/120 days	Subsequent ED visits (2 hospital records)	No signif. diff. in repeated ED visits, 30 or 120 days (I) vs (UC): OR: 0.96 (95% CI 0.71–1.31) for 120 days); no diff. when stratified by risk	Hospitalization, hospital days, nursing home admission (self-report), physical/mental health, physical and mental health, satisfaction with nursing care, satisfaction with information provided through intervention	No signif. diff. in hospitalization, hospital days; stratified by risk: high risk fewer hospital days, lower odds of nursing home admission for (I) vs (UC) at 120 days; No signif. diff. mental/physical health, (I) higher satisfaction vs (UC); higher use of community referrals among (I)	Health care cost: ED use, hospitalizations (units multiplied by Medicare reimbursement rates)	No signif. diff. in costs for subsequent ED visits, hospital admissions, at 120 days	High
Kolbasovsky, 2007	Adult plan members presented to ED with anxiety diagnoses (note that Medicaid members more likely to be excluded bc left plan)	Identified from claims data and contacted by telephone (avg. 1-2 mo postdischarge), (I): N=307	Randomized to usual care (UC): N=300	RCT		Northeast (not specified), multiple EDs (based on health plan claims)	(I) Stepped intervention: all: (1) mailed information on anxiety, outpatient treatment options, importance of PCP involvement, contact information to access treatment; if a participant randomized to the	6 mo postintervention	Count of ED visits w/ psychiatric diagnosis (claims data)	Decreased count of ED visits: (UC) vs (I): adjusted IRR, 1.35 $P<.01$, implied that UC is the reference category; note that although both UC and Medicaid pos. assoc.	Psychiatric outpatient visits (claims data)	No signif. diff. in the number of psychiatric outpatient visits	Cost of ED visits and outpatient psychiatric visits (claims); program costs (case manager time ($0.98 per person per month) and cost of mailing letters ($0.06 per person per month); net	Decreased total, pmpm ED costs (I) vs (UC) ($11.77 vs $19.69 pmpm) ($P=.01$ for adjusted analyses); sex/Medicaid interactions also signif.: (I) women lower ED costs; (I) men lower ED costs only if non-Medicaid; higher cost of psychiatric	High

								intervention group returned to the ED for a psych condition within 6 mo, then (2) case manager telephone contact to conduct needs assessment, treatment options, and connect the member with outpatient care; case manager conducted additional calls as needed; (UC): psych referral at ED discharge, access to ≥20 mental health visits			w/number of ED visits, interaction term of 2 factors is negative, sugg. effect of inter-vention reduced for Medicaid patients			cost: cost of ED and psychiatric outpatient visits and cost of the program (case manager time and mailing letters); total and per member per month (pmpm)	outpatient visits for the intervention group ($0.91 pmpm) compares favorably, savings decrease ED use ($7.01 pmpm); net savings est. $5.97 pmpm, for an overall net savings for all 607 members in the intervention of $21,742.74 over 6 mo.	
Horwitz, 2005	Adults presented to ED, no PCP, no substance abuse/ mental illness	Recruited in study ED during designated shifts, (I): N=121	Randomized to usual care (UC): N=109	RCT, randomized by shift	2002	New Haven, CT, Yale–New Haven Hospital	(I): Health promotion advocates: assist choosing PCP, faxed information to PCP; PCP case managers contact/ schedule appoint-ments (by telephone, mail, home visits); assist w/ setup of other (?) services	6 mo postinter-vention	ED visits (hospital records, the 2 hospitals in the city)	No diff. in probability of any ED visit: (I) vs (UC): RR 1.07 (0.72–1.58)	Hospitalizations (hospital records), follow-up PC visit (medical records of 4 primary care sites)	No signif. diff. in hospitali-zation, (I) vs (UC): RR 0.39 (0.10–1.46); increased likelihood of PC follow-up, (I) vs (UC): RR 2.46 (1.45–4.19)	Average cost of return ED visits (single hospital claims)	Decreased average cost per visit (I) $243 vs (UC) $319 for usual care group, no stat. testing reported	Moderate
ED diversion																	
Doran, 2013	Patients presenting to ED with low-acuity concerns, defined as recognizable by a layperson, ≥23 y, afebrile, triage indicated no need for ED care	Identified in ED during primary care clinic operational hours, selected according to speed of care: primary care clinic availability and lack of urgent care availability (I): N=662	Identified in ED, deter-mined that urgent care would result in least delay, ie, urgent care availability or no primary care clinic availability: (UC): N=191 Secondary compari-son group: patients eligible but	Pre/post, equivalent comparison group, multivariate adjustment for con-founders, difference-in-differences analysis	2007–2008	New York, NY, Bellevue Hospital Center	(I) Referral of low-acuity ED patients to onsite primary care clinic: (1) primary care (PC) clinic navigator used VoIP system to communi-cate onsite PC walk-in availability to ED navigator; (2) ED navigator referral of low-acuity patients to PC if estimated wait time less than	12 mo pre/ postinter-vention	Mean ED visits (single hospital records)	No signif. diff. in ED visits: (I) vs (UC): adjusted DID (−0.23) (95% CI −0.61 to 0.16)	Primary care follow-up (single system records); patient ratings of quality of care (6 mo postinter-vention satisfaction surveys)	Higher likelihood of PC follow-up (I) vs (UC): risk difference 9.3% (95% CI 2.2% to 16.3%); no signif. diff. in DID number of PC visits; odds of rating quality of care "very good": adjusted odds higher for (I) vs (UC)	Not studied		Moderate

Table 4. Continued.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
			with a primary care physician outside hospital system, (UC): N=112				estimated time to evaluation in the ED urgent care (UC) clinic (3); navigator walked patient over to PC clinic, assistance w/ registration/ orientation; (4) patient existing PCP contacted/ otherwise assigned PCP, given card and contact info; (5) assistance w/ financial as needed for uninsured; (UC): evaluation in ED urgent care clinic, given PC appointment at discharge								
Financial penalties															
Lowe, 2010	Medicaid adult enrollees	"Optional" Medicaid adult enrollees (Oregon Health Plan Standard, OHP-S) N=321,622	Mandated-eligible Medicaid adult beneficiaries (OHP Plus, OHP-P) N= 179,484	Pre/post non-equivalent groups	01/01–01/04; Policy change 2003	Oregon	Oregon Health Plan Policy changes: Introduction of $5 copayments for primary care, $50 copayments for ED visits, $50 for emergency transportation, $250 for hospitalizations, dropped benefits for outpatient mental health, substance abuse treatment, dental, vision, nonemergency transportation; providers allowed to refuse services according to inability to pay; premium increases and forced disenrollment	Preintervention (1): 14 mo; intervention period (2): 15 mo; partial reversal of intervention (3): 7 mo	Change in no. of ED visits/ enrollee/ year; adjusted for patient factors; claims data	Rate ratio of RRs: Change from period (1) to (2): 0.82 (95% CI 0.80 to 0.84) (OHP-S vs OHP Plus). Change from (3) to (2): RRR=1.01, (95% CI 0.97 to 1.04); change from (3) to (1) RRR=0.82, 95% CI 0.80 to 0.85	ED visits leading to hospital admission; injury-related ED visits; psych-, drug-, alcohol-related ED visits	Similar findings for ED visits leading to admission and injury-related visits	Not studied		Moderate

Wallace, 2008	Medicaid adult enrollees, aggregated to 59 primary care service regions	OHP Standard, N=10,176	OHP Plus, N=10,319; propensity score matching	Pre/post non-equivalent control groups	2001–2004	Oregon	OHP policy changes (see above, Lowe 2010)	Preintervention: 11/01–10/02; postintervention: 5/03–4/04	Change in average monthly probability of ED use per region; (claims data, managed care encounters)	OHP-S: –6.2%; OHP-P: 1.8%; DID –7.2% (*P*=.03)*	Change in probability of total and other services use, including hospital inpatient, outpatient, per region	Hospital inpatient: DID: 27.3% (*P*<.001)	% Change/person: total, ED, hospital, outpatient expenditures; also % change/user; based on average FFS rates for state	ED expenditures: % change/person: DID 2% (*P*=.68; % change/user: DID 7.9% (*P*=.03); total expenditures: %/person: DID: 2.2 (*P*=.47) %/user: DID: 5 (*P*=.10)	Moderate
Mortensen, 2010	Medicaid adult enrollees, sampled in MEPS	Residents of 9 states that increased Medicaid copayments, N=17,952 person-months	Residents of 29 states w/o copay increases; N=70,368 person-months; propensity score matching	Pre/post non-equivalent control groups	2001–2006	38 US states	States increased copayments for nonemergency ED visits, ranging from $3 to $50	2001–2006	Any ED visit/month, any nonemergency ED visit/month, any emergency ED visit/month (self-report: MEPS)	After copay increase: any ED visit: 0.00420 (SE 0.005); any nonemergency ED visit −0.00006 (SE 0.0003); any emergency ED visit: 0.00425 (SE 0.004), findings non-significant	Any ED visit/year; Additional analyses on uninsured and privately insured	No significant findings for ED visits/year; no changes among uninsured/privately insured	Not studied		Moderate
Hsu, 2006	Kaiser Permanente Northern California members; Medicaid enrollees excluded	Members whose employers sought ED copayment increases	Concurrent members w/$0 copayments; propensity-score matching	Pre/post non-equivalent control group	1999–2001	Northern California	ED copayments: $1–$5, $10–$15, $20–$35, and $50–$100; Medicare members: $1–$15, and $20–$50; ED copayments >$20 paired with office visit copayments (adjusted in model); copayment levels used as variables in analysis, N=2,257,445 at baseline, 23% had $0 copayment at baseline	36 mo	ED visits/month; internal clinical database plus claims for external visits	Adjusted relative rate (ref: $0) $1–$5: 0.962 (0.955, 0.970); $10–$15: 0.932 (0.922, 0.941); $20–$35: 0.879 (0.873, 0.886); $50–$100: 0.765 (0.756, 0.774) (declining ED visit rate w/ increasing copayment)	Hospitalizations, deaths, "unfavorable clinical events": ruptured appendix admissions, ICU PNA admissions	Trend toward decrease in hospitalizations; no association with higher unfavorable clinical event rates	Not studied		High
DeVries, 2013	Commercially insured	Members of participating employer group, N=14,244	Concurrent members of nonparticipating employer	Pre/post non-equivalent comparison group	2009–2010	Northern Virginia	ED copayment increases: $100–$200; mailed brochure on	6 mo	ED visits/year; acute nonlife-threatening ED visits/	DID –2.66% (relative change in ED use rate)	Retail health clinic (RHC) visits/year	DID 81% (relative change in RHC use rate)	Not studied		Moderate

Table 4. Continued.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
			groups, N= 42,672; propensity-score matching				nonemergency conditions, locations of local retail (RHC) and urgent care clinics (UCC), nurse telephone line; Google Maps applet on RHC/UCC; nonemergency ED users also received another mailing and a follow-up call on alternative sites after ED visit		year; emergency ED visits/ year	DID −14% (relative change in non-emergency ED use rate); no change in emergency ED visit rate					

ED, Emergency department; *UC*, usual care; *CM*, case manager; *I*, intervention group; *FPL*, federal poverty level; *IRR*, incidence rate ratio; *PCP*, primary care provider; *OR*, odds ratio; *CI*, confidence interval; *DID*, difference in differences; *PC*, primary care; *RRR*, relative risk reduction.

standardization makes it challenging to conclude definitively which programs may reduce ED use. Many ED visit reduction programs either do not report or do not collect data, or have not published results in the peer-reviewed literature. We did not include studies of programs published outside of the peer-reviewed scientific literature. Publication bias may have affected our results.

DISCUSSION

We found that several types of ED visit reduction programs exist, and our typology may be useful to standardize future research in this area. In contrast to previous reviews of ED visit reduction programs,[8-11] we limited our review to studies of ED visit reduction programs that were moderate to high quality. Health care payers and policymakers are interested in implementing ED visit reduction programs to achieve cost savings while maintaining or improving quality, and many states and large foundations have invested in these efforts.[2,52] The small number of studies that qualified for our review highlights a lack of evidence about program effectiveness. In addition, even among the studies we categorized as moderate to high quality, most were moderate quality and very few were randomized controlled trials. As a result, some of the inconsistencies we found in study results could reflect inadequate rigor of program evaluation study designs.

Among studies of programs focused on high-risk patients, we found evidence for the effectiveness of case management in reducing ED use among high-risk patients.[39-41] Although the collective findings of the case management studies we included in our review suggest that they are effective in reducing ED use for high-risk populations, stronger evidence is needed about program cost-effectiveness, given the intensive resources required for such interventions. A review of ED visit reduction programs by Althaus et al[10] that focused on frequent ED users concluded that case management interventions reduced ED costs. In contrast, we found that only 5 of the 13 studies we reviewed reported data on health care costs,[39,40,43,44,50] and these data were insufficient to draw valid conclusions. Data on the financial influence of ED visit reduction programs will be essential for future research.

We rated the majority of studies focused on programs targeting high-risk individuals as low and very low quality because there was no equivalent comparison group (Table E2, available online at http://www.annemergmed.com). Regression to the mean can bias the results of programs focused on reducing ED use among frequent ED users toward a treatment effect if no comparison group is

identified and will prevent policymakers from drawing valid conclusions.

Among the studies of programs focused on reducing low-acuity ED visits, only ED visit copayments resulted in significant ED visit reductions, although there were conflicting results among the studies of ED visit copayments for Medicaid beneficiaries. A multistate Medicaid study reported no difference in ED use among beneficiaries in states with and without ED visit copayments, even though a separate study that focused on one of the states (Oregon) found ED visit copayments to be effective in reducing ED visits. The difference in the findings between the multistate study and the Oregon study may be attributable to the size of the ED visit copayments. In most states, copayments range from $2 to $8 per ED visit for Medicaid beneficiaries, but in Oregon they were $50. In contrast to other intervention types that require hiring dedicated staff, ED copayment programs are largely administrative and thus low cost, and can be implemented quickly across a large insured population. However, imposing penalties for ED use could result in delays in needed care, especially for low-income populations, who often lack timely access to outpatient care.[53,54]

A previous review of care coordination interventions by Katz et al[8] concluded that ED-based care coordination interventions, most of which involve interfacing or referring to outpatient primary care providers, were effective. The quasi-experimental studies included in that review were more likely to find that an intervention reduced ED visits compared with higher-quality, randomized controlled trial study designs. Although the scope of our program types included in our review was slightly different than that of Katz et al, we did not find evidence that strategies that attempt to reduce ED use by expanding primary care hours or initiating linkages to primary care for patients in the ED are successful in reducing ED visits.[41-44] Many ED visit reduction programs assume that primary care can serve as a lower-cost substitute and reduce overall demand for ED care.[55] Yet there is also evidence that the ED may be serving as a safety net for an overburdened primary care system.[56] Recent research by RAND[57] indicates that primary care providers may be relying on the ED to initiate evaluations that are not feasible in an outpatient setting.

We did not address new models of primary care delivery, such as that delivered through patient-centered medical homes, which provide panel management, more on-demand services for patients such as same-day appointments, and a higher level of care management and care coordination than what is delivered in a traditional primary care practice.[58] It is possible that although ED visit reduction is not their primary goal, enhanced primary care practices could be effective in reducing the use of ED services, decreasing health care costs, and improving patient outcomes.[59]

There is widespread policy interest in reducing ED visits; this interest has driven the development of programs that seek to decrease ED use. However, moderate- to high-quality studies that examine ED visit reduction programs in the peer-reviewed literature are limited, and our review, when limited to studies of moderate to high quality, arrived at conclusions different from those of previous reviews. Case management for high-risk individuals is the only intervention that the literature has found to consistently reduce ED visits. ED visit copayment has been found repeatedly but not always to be effective in reducing ED visits; its effectiveness may in part be related to the size of the copayment. The data on the costs of ED visit reduction programs are insufficient to determine whether any of these programs are cost-effective. Therefore, it would be appropriate to continue to regard ED visit reduction programs other than case management programs as demonstrations rather than proven interventions and to pursue evaluations that overcome the limitations we have highlighted in the existing peer-reviewed literature.

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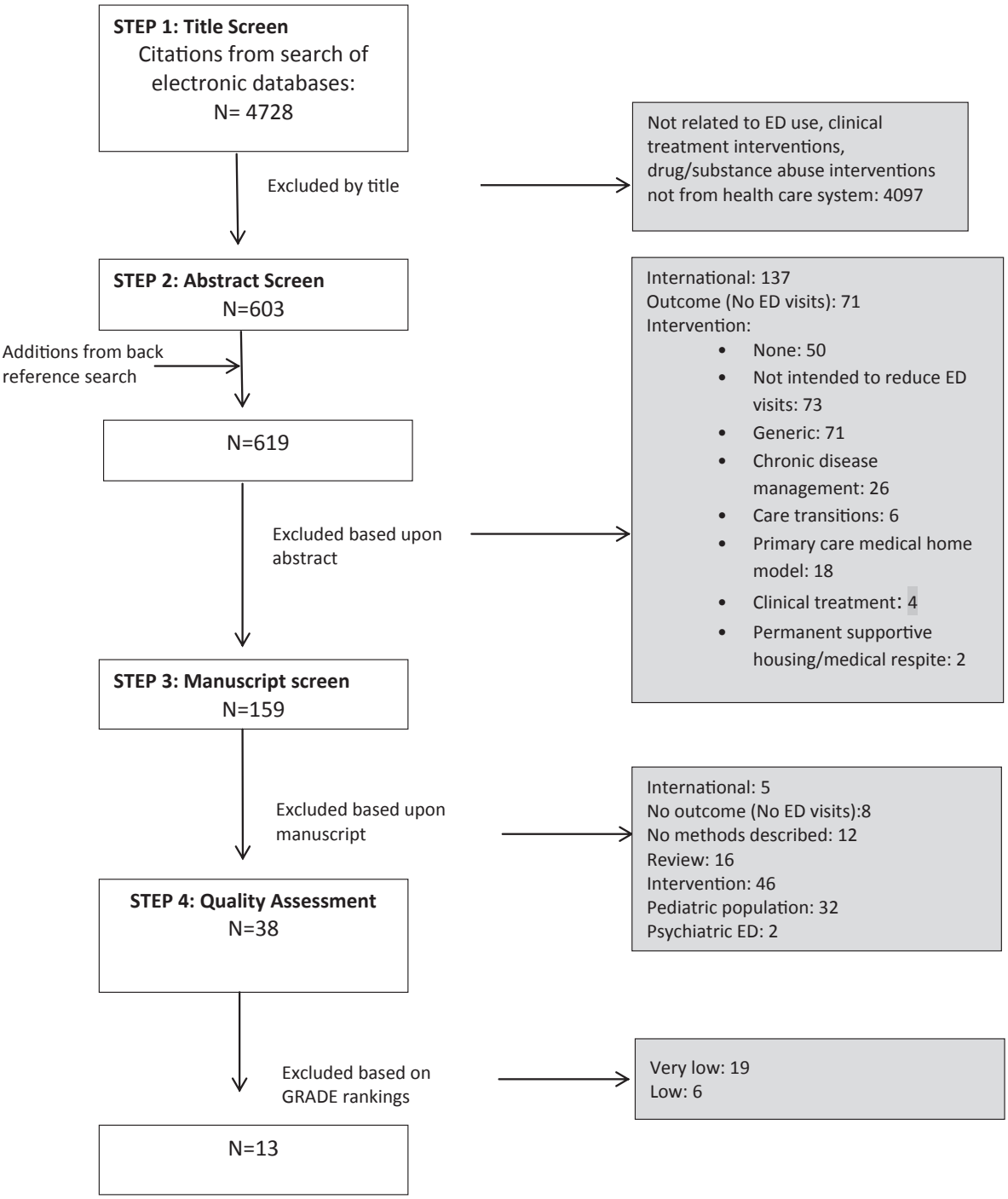

Figure E1. Flow chart of selection of studies for inclusion in literature review.

Table E1. GRADE quality rating criteria and GRADE approach to rating quality of evidence.[1]

Study Design	Initial Quality	Rater Lower If	Rate Higher If	Quality
Randomized trials	High	Risk of bias	Large effect	High: ≥4
Observational studies	Low	−1 Serious	+1 Large	Further research is very unlikely to change confidence in the estimate of effect
		−2 Very serious	+2 Very large	
		Inconsistency	Dose response	Moderate: ≥3
		−1 Serious	+1 Evidence of a gradient	Further research is likely to have an important effect on confidence in the estimate of effect and may change the estimate
		−2 Very serious	All plausible residual confounding	
		Indirectness	+1 Would reduce a demonstrated effect	Low: 2
		−1 Serious	+1 Would suggest a spurious effect if no effect were observed	Further research is very likely to have an important effect on confidence in the estimate of effect and is likely to change the estimate
		−2 Very serious		
		Imprecision		Very low: 1
		−1 Serious		Any estimate of effect is very uncertain
		−2 Very serious		
		Publication bias		
		−1 Likely		
		−2 Very likely		

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Table E2. Descriptions and characteristics of studies of ED visit reduction programs rated low and very low.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
High-risk programs															
Case management															
Johnson, 2012	Medicaid enrollees with ≥3 ED visits/ quarter	Identified from claims, (I): N=448	≥3 ED visits, top resources consumers not already receiving other care coordination/ management services (UC): N=448	Pre/post non-equivalent comparison groups	2007–2009	Albuquerque, NM	(I) CHWs: home visits: navigating health care system, assistance w/ community resources and transportation, establish medical home, assist and attend appointments, education to reduce preventable ED visits, chronic disease management education and adherence; health literacy and interpreter services. (UC): ?	(1) 6 mo preintervention; (2) 6 mo during; (3) 7–12 mo postintervention	Mean ED visits/ person ED (claims)	Decreased ED use from during intervention to postperiod([2] to [3]): (I) vs (UC) ($P<.01$); but for overall use from start to end of study ([1] to [3]), (UC) showed greater declines than (I) ($P<0.01$) (difference statistics not reported).	Mean per-person hospitalizations, prescriptions, narcotic use	Hospitalizations decreased: (I) (0.4 to 0.1 visit per person;) from period 1–3; prescriptions: greater decline for UC from period 1–3; narcotics: no signif. diff. between groups; primary care and specialist visits: UC: decreased by 1/2 from period 1–3 vs no change for CHW (stats not reported)	Health care costs, measured as payments for services; program costs, measured as salaries and benefits for program staff plus management fees paid to primary care providers; total costs, measured as payments from ED, inpatient and prescription services	ED payments decreased for (UC) relative to (I) from period 1 to 3; inpatient payments decreased period 1 to 3: (I) ($2,358 to $410); total costs for CHW members declined $2,044,465 (no comparison to non-CHW members provided); stated costs of program as $521,343.	Very low
Michelen, 2006	Presented to ED with history of ≥3 ED visits in previous 6 mo for non-emergency conditions	Flagged by tracking system on presentation to ED, not specified if recruited during or post-ED visit, N=539 (N=537 at 3 mo, N=117 at 6 mo)	Participants serve as own controls	Pre/post, participants serving as own controls	2003–2004	New York City	Event monitor software to ID use; health priority specialist (MD): individual care plan, including primary care referral, education, navigation, counseling; follow-up if repeated representation to ED; community health workers: outreach and patient assessments, contact w/ health priority specialist	3, 6 mo post-enrollment/ program start	Mean ED visits (ED tracking system, single ED), ED visits by severity classification: emergency, preventable, primary care treatable, nonurgent	Decreased mean ED visits: 4.06 (SD 1.62) (preintervention), 0.99 (SD 1.46) (baseline), 0.99 (SD 1.46) (3 mo), 0.77 (SD 1.34) (6 mo); no signif. diff. by severity classification	Associations between specific program elements and ED visits	3 mo: primary care referral correlated with no. of ED visits ($P=.02$); 6 mo: health education, social, emotional counseling correlated with ED visits ($P<.001$); education on health system navigation negatively associated with ED visits: Pearson correlation coefficient −0.259, $P=.001$)			Very low

Raven, 2011	Hospitalized adults 18–64 y, high risk for readmission, Medicaid fee for service	Identified with risk prediction modeling tool, enrolled in ED or floor, N=15 or 10 (actively engaged)	Participants serve as own controls	Pre/post, participants serve as own controls	2007–2008	New York, NY	Intensive case management: community-based care manager: bedside needs assessment, evaluated for housing by the Common Ground Community (discharge either to permanent housing or housing at the YMCA); community services tailored to individual needs (eg, transportation to appointments, assistance with entitlements enrollment, home visits, connection of patients to other needed medical and nonmedical services); all patients provided prepaid cellular telephones (for reminder calls and crisis management); expedited medical appointments; care team met weekly to review care plans	1 y preintervention/1 y postintervention	Number of ED visits (hospital records and Medicaid claims data)	No significant decrease in ED visits: pre/post decline: 0.7 visits (P=.77)	Number of hospitalizations, clinic visits, service delivery	Mean annual decrease in hospitalizations: −1.6 visits (95% CI −4.03 to −0.83); case management: mean 11 h/mo, mean 17.6 contacts/participant per month; increased outpatient clinic use: mean visits increased 0.72 (P=.048)	Net costs: health service costs (inpatient admissions, ED use, outpatient clinic use) (Medicaid reimbursements) vs costs of running the program (measured as personnel with fringe costs, patient necessities, payment for transitional housing, mobile telephone costs, office supplies, travel expenses for patients, and computer costs)	Total annual Medicaid reimbursements to the study hospital decreased: mean $16,383/participant per year (−$1,712 to $34,478); total annualized intervention costs for the project: $169,551; total reduction in Medicaid spending $245,745, for a net reduction in Medicaid spending of $76,194, or $5,080 per participant	Very Low
Wetta-Hall, 2007	Frequent users (≥3 visits/6 mo), uninsured	Identified by ED use, invited to participate in program by letter, follow-up telephone calls,	Participants serving as own controls	Pre/post, participants serving as own controls, qualitative comparison to US population	2001–2004	Sedgwick County, KS	Team provides (in person and telephone calls) nursing and social needs assessment, goal setting with the client, coordination of referrals,	6 mo preintervention/6 mo postintervention	Number of ED visits (hospital records)	Total visits declined 48%, w. mean 6.1/person to 4.3 postenrollment	Health status (SF-8), beliefs on health behaviors (Multidimensional Health Locus of Control [MHLC] scale), at enrollment and 3 mo after disenrollment	Self-reported physical health improved (SF-8 score increased from 35.5 to 41.3); no significant differences in mental health	Costs (hospital/physician charges for ED visits); multiplied by number of ED visits reduced, compared	Estimated reduction in costs, measured as charge avoidance: $1,446,280, vs program costs of $750,000.	Very low

Table E2. Continued.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
		flyers, and brief home visits, N=492					education, and supporting client connections to informal support networks. Direct interventions: matching of clients to agencies, initial agency contacts, client orientation to services and form completion, visits to agencies and providers for clients.					status, MHLC scores	to costs associated with case management program (not specified)		
Grover, 2010	≥5 ED visits for care of chronic conditions, including narcotic/benzodiazepine addiction	Identified from ED records, referrals from staff, flagged from California prescription monitoring program, N=85	Participants serving as own controls	Pre/post, participants serving as own controls	2006–2008	Central California	Case management team: develops plan of care (includes referral to outpatient resources or social services and recommendations for treatment during future ED visits, including restrictions around pain medicine dispensation), plan mailed to participants, uploaded to systemwide, enrolled patients flagged on the ED status board; team meets monthly	6 mo pre/6 mo post	Number of ED visits per patient per month, chief complaint bringing patient to the ED	Decreased ED visits: mean: 2.3 ED visits/patient per month (pre) to 0.6 (post) ($P<.001$); no difference in distribution of chief complaints	Admission rates, attendance at follow-up visits to which patients were referred, number of CT scans per patient per month	Decreased CT scan use: 25.6/patient per month to 10.2/patient per month ($P=.001$); no signif. diff. in proportion of ED visits leading to admission	Savings: calculated by multiplying average cost of ED visits (estimated as charge of $1,000) by number of ED visits reduced, estimated 2,000 per year	Estimated savings to hospital and health plan ≈$2 million annually	Very low
Navigation and care coordination															
Marr, 2008	Patients presenting to ED who lack a	Recruited in ED, N=7,185 lacked a		Pre-post: for ED visit analysis conducted		Chicago, IL	ED tracking system identifies patients w/o a medical home;	18 mo post=start of program	Frequent user (≥3 ED visits) visits (single	No change in frequent user visits compared	Primary care appointments scheduled, follow-up appointments	Postintervention, 43% had PC appointment scheduled;			Very low

	primary care medical home	PCP and accepted referral services		on single hospital changes, not individuals; post only, no comparison group, for other outcomes			ED patient navigator conducts needs assessment (inventory of medical issues requiring primary care, mental health and substance abuse history, and current living situation), educates patient around appropriate use of PCP vs ED care, offers patient a referral to primary care, and faxes ED medical data to the primary care office; ED-based social workers offer brief motivational interviewing, outpatient home health care, and direct nursing home placement; navigators actively engage in the care of patients within their neighborhoods	hospital records)	with 26% increase in year before implementation	attended, return visits after initial appointment	14% (of all eligible) attended first appointment; 39% (of all with first appointment) returned to PC clinic $\geq$2 visits	
Pillow, 2013	50 patients with the highest number of ED visits in past 12 mo	Patients flagged in ED on arrival	Participants serving as own controls	Pre-post study				Variable follow-up period between Jan 2007 and May 2008	Total number of monthly ED visits for 50-person study sample	Decrease from 94 visits/mo to 88 visits/mo	Total number of monthly hospital admissions for 50 person study sample	Decrease from 31 admissions/mo to 28 admissions/mo	Very low
Acute disease management and education													
Asthma													
Tatis, 2005	Adults presented to ED w/ asthma	Identified from ED logs, asthma educators invited eligible patients (by	Sex- and date-of-ED-visit-matched patients who did participate (UC): N=198	Pre/post nonequivalent comparison group, qualitative comparison	2000–2002	New York, NY	Visits to designated asthma clinic, pulmonologists provide asthma education; asthma educators then independently	12 mo preintervention/12 mo postintervention	Mean ED visits (unclear whether self-report or based on single ED records)	Decreased mean ED visit rate: (I) –28% vs (UC) no change; no testing for stat signif. betw. groups	Hospitalizations, health-related quality of life (Juniper 15), asthma knowledge quiz	Decreased hospitalization rate (I) 41% vs (UC) 7%; QOL and symptoms improved from (I), no diff. in asthma knowledge; no	Very low

Table E2. Continued.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
		telephone and mail), (I): N=198					review education with patients, provide educational booklet; nurse conducts home visit if continued difficulty with asthma management. Asthma educators attempted to contact patients who failed to follow up on appointments.					testing for stat. signif. betw. groups			
Other															
Desy, 2010	Adults presented to ED, screen positive for at-risk drinking	Recruited from ED, randomized, (I): N=26 (5% of all eligible patients)	Eligible and randomized to control (UC): N=20	RCT	2006–2007	Lexington, KY	(I) in ED: RN: SBIRT (screening, brief intervention: 5- to 10-min motivational counseling, educational brochures, referral to treatment); (UC) referral only	3–9 mo postintervention, varied, depending on ability to contact patients	Any recurring ED visit (single hospital records)	No signif. diff. in recurrent ED visit ([I] 20% vs [UC] 31%)	Alcohol consumption	No signif. diff. in alcohol consumption			Very low
Givens, 2007	Patients presented to with sickle cell crisis	Identified in ED, N=single ED/medical center	Participant ED/medical center as control	Time series	2000–2003	Dallas, TX	Pain management guidelines for sickle cell crisis eliminating meperidine; recruitment into hematology clinic for primary care after discharge; case management started June 2003.	1 y pre–start date/3 y post–start date	Trend in ED sickle cell visits over time (single hospital records)	ED visits for sickle cell disease decreased (446 to 201) relative to hematology clinic visits ($P<.001$ for trend)	Hospitalization with primary/secondary diagnosis of sickle cell, hematology clinic visits (single medical center records)	Hospitalizations declined during 4 y; proportion of ED admission leading to hospitalization increased (29% to 43%, $P=.04$);			Very low
Pain management, health technology, and patient education															
Chronic noncancer pain management															
Svenson, 2007	Presented to ED for nonmalignant pain/headache ≥10 times/y and treated	Identified through (hospital? claims?) administrative database, N=15	Participants serving as own controls	Pre/post, participants serve as own controls	Not stated	Blinded for publication	(1) Frequent users mailed letter explaining the use of narcotics in rescue therapy, the primary care physician's role in prescribing,	1 y preintervention/1 y postintervention	ED visits (single ED records)	Mean annual ED visits decreased: 19 (pre) to 2 (post); estimated total reduction 255 visits	Weaned off narcotics, use of long-acting narcotics (clinic records)	7 weaned off, 4 switched to methadone, 1 converted to fentanyl patch	Savings: calculated as multiplied by average total per patient cost (physician, pharmacy,	Cost savings of $200,000	Very low

	with narcotics						that ED would no longer provide parenteral narcotics; (2) PCPs also mailed alert to new program; (3) non-narcotic pain management offered if re-presented to ED						hospital bills) $800, by estimated number of ED visits reduced		
Masterson, 2012	Patients presented to ED w/ pain complaint and ED overuse, drug-seeking behavior, drug addiction, driving after receiving judgment-impairing medi-cation, request by PCP, threa-tening behavior toward ED staff, or history of providing false demo-graphic infor-mation	Referred to ED case manager by ED physician or PCP, N=134	Participants serving as own controls	Pre/post, participants serving as own controls	2006–2009	Spokane, WA	Care plan developed for each patient, one of following options: (1) continue care as is but monitor ED use, (2) recommend and assist with admission to a chemical dependency treatment program, (3) provide closer care coordination with PCP, (4) restrict access to narcotics/ controlled substances, (5) initiate a non-narcotic treatment regimen, (6) restrict the patient's care to 1 physician and 1 pharmacy, (7) refer the patient to an alternative pain management program; care plan posted on electronic medical record (accessible to most major health care facilities in a 150-mile radius) and sent to the patient's PCP; revised as needed	1 y preintervention/ 1 y postintervention	Annual ED visits (multifacility records)	Mean ED visits decreased: 27.5 visits (pre) to 6.3 (post) ($P<.001$); visits also decreased when stratified by high ($\geq$24 visits/y pre) vs low users	Identified PCP	Patients w/ identified PCP increased from 42% (pre) to 89% (post)	Estimated from reduction in visit use, methods not reported	Savings to the study hospital: $7.5 million	Low

Table E2. Continued.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
Woodhouse, 2010	Patients presented to ED with chronic pain	Patients identified in the ED, total N=25; stratified by high users (≥+ visits/6 mo), N=13	Low ED users (<4 visits/6 mo), N=12	Pre/post, non-equivalent comparison groups	Not stated	Newberg, OR	Psychology doctoral students: brief education intervention in ED, discussed treatment options other than opioids, educated around appropriate use of the ED and primary care, provided linkage to primary care when necessary and referral to a 10-week ED-based pain management group; behavioral health intern: contacted patient within 1 wk of ED visit to encourage pain management group attendance; if patient returned to ED, provided a series of increasingly stern letters explaining restrictions around pain treatment in the ED; ED established pain treatment policy, including not prescribing Demerol or methadone	6 mo pre/6 mo post	ED visits (assumed single ED, not stated)	Decreased mean ED visits: 6.8 (pre) to 4.0 (post) for high users vs no change for low users, (*P*=.004)					Very low
Health technology															
Stokes-Buzzelli, 2013	Frequent ED users	Top 100 users of ED identified from hospital record, adults,	Participants serving as own controls	Pre/post, participants serving as own controls	2005–2007	Detroit, MI	(1) Frequent users identified in the electronic medical record; (2) program committee member developed a	Range 3–23 mo	Number of ED visits, total ED contact time (single hospital records?)	Mean number of ED visits decreased: 67.4 (pre) to 50.5 (post) *P*=.046, ie, −16.9 (95% CI −33 to −3)	Number of laboratory studies ordered, average length of stay	Mean laboratory studies decreased (95% CI for difference=26 to 1,252), nonstatistically significant	Total ED charges	Mean reduction in ED charges after intervention of $15,513 (95% CI $83 to $30,943)	Very low

		non–sickle cell, N=45					patient summary and treatment guidelines, which were uploaded to the electronic medical record and patient was flagged in the ED information system; (3) patient care plans evaluated monthly					decrease in length of stay	
Abello, 2012	Frequent ED users with psychiatric diagnostic codes, particular medical concerns, history of problematic behaviors	Recommendation of the ED staff, N=48	Participants serving as own controls	Pre/post, participants serving as own controls	2006–2007	Austin, TX	Team generates care plan accessible in a subprogram of the hospital's EMR interface. The case manager and medical director approve comments to be included in the care plan, which can be made by other providers. Care plans are discussed with patients on their next ED visit and reviewed and modified on a regular basis. Collaborative effort across 3 hospitals.	1 y preenrollment/1 y postenrollment	Number of ED visits (program database, county indigent care database, included ED visits for 1 other major hospital system in Austin)	Decreased ED visits: 8.9 (pre) to 5.9 (post) ($P<.05$);	Use of psychiatric treatment in lieu of ED visits, response to the program	Increased psychiatric inpatient admissions: 2% (pre) to 25% (post)	Very low
Patient education													
Ma, 2004	Patients presented to ED with uncomplicated odontalgia	ED visits identified from *ICD-9* codes to single ED; return visits analysis, preintervention N=3,353	ED visits back pain, ankle sprain, and simple arm lacerations (surrogate indicator of ED visits for uncomplicated pain-related conditions), comparison of distribution in single ED; return visits analysis, postintervention N=2,577	Pre/post, single ED; pre/post historical controls for analyses on ED return visits	1999–2001	Cincinnati, OH	During/at end of ED visit, provided guidelines for treatment of uncomplicated odontalgia, information on resources for treatment; physicians advised to use nonsteroidal anti-inflammatory drugs in preference to narcotics for controlling pain (but prescribing still done at	1 y preimplementation/1 y postimplementation	Proportion of odontalgia-related visits, proportion of patients with at least 1 return visit (within 2 mo of index), (single hospital records)	Proportion of all visits for odontalgia decreased from 4.3% (4.2%–4.5%) (pre) to 3.1% (3.0%–3.2%) (post) proportion of visits for back pain, ankle sprain or arm lacerations changed only by 0.1%; percentage with return visit to ED w/ in 2 mo: 19.8% (pre) to	Proportion of visits involving narcotic dispensation (based on filled prescriptions)	Percentage filling narcotic prescriptions for tooth pain decreased by 20.1% (from 29.6% to 9.5%)	Very low

Table E2. Continued.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
							discretion of the physician)			9.2% (post), reduction −10.5% (95% CI 8.3% to 12.8%)					
Ambulatory ICU															
Brown, 2005	Patients with high level of "inappropriate" admissions, ED visits, frequent outpatient visits, or frequent telephone calls, ≥1 admissions in previous year, ≥1 chronic conditions, life expectancy >3 y	Referral from primary care providers or inpatient care coordinator, N=17	Participants serving as own controls	Pre/post with participants servings as own controls	Not stated	New Haven, CT	Primary intensive care clinic: longer appointment times for evaluation, multidisciplinary assessment and follow-up (including mental health services), frequent visits with patients (weekly initially), and 24-h availability with a team member on call; each patient was seen by the psychiatrist, internist, and care manager at initial visit; care plan developed and presented to patient; patients seen weekly until their clinical and utilization status was stabilized, and then visits tapered off	5–12 mo pre- and postenrollment	Number of ED visits (administrative database, number of EDs/hospitals not specified)	Decreased mean number of ED visits: 6.9 (pre) to 4.9 (post) (P=.05); No signif. diff. in mean number of visits per month	Number of hospitalizations	Mean hospitalizations decreased: 0.3 (pre) to 0.1 (post) (P=.02); mean inpatient days/month decreased: 1.4 (pre) to 0.6 (post), (P=.05);	Hospital cost per month, data source or methods not specified	Mean cost/month: nonsignif. decrease after intervention: $1,904 (pre) to $1,537/mo (post)	Very low
Low-acuity programs															
Linkage to primary care and care coordination															
Chan, 2009	Low-income patients getting discharged from the ED without a primary care provider	Identified in the ED, self-reported as not having a primary care provider or clinic, given an appoint-	Patients given a standard referral to primary care providers before program implementation (UC): N=399 (6 mo before	Pre/post with historical controls	Not stated	San Diego, CA	Partnership between hospital and 3 federally qualified health centers (FQHCs). ED clinicians notified through the electronic medical record if patient	2 wk	ED visits within the 2 wk of the index ED visit (single hospital records)	No signif. diff. in likelihood of return visit to ED 11.7% (I) vs 14.8% (UC)	Follow-up at community clinic within 2 wk of index visit	Increased likelihood to visit primary care clinic: 24.8% (I) vs 1% (UC)			Low

		ment to FQHC (I): N=326 (6 mo after program start)	program start)			reported not having primary care; ED physician worked with patient to schedule an appointment in the electronic referral system, which was embedded in the EMR; patients were given information on appointment time, FQHC contact information, map and bus routes; FQHCs received the patient information electronically						
Enard, 2013	Patients presenting to ED who have primary care–related (PCR) ED visits	Recruited in ED according to triage acuity score at 1 hospital ED	Nonequivalent comparison group that did not receive intervention (n=11,737)	Pre-post observations at 12 and 24 mo for intervention and comparison groups	Houston, TX	Patient navigators (PNs) engage patients to identify specific barriers to appropriate primary care use and determine resources that can support the clients' medical and social needs. The PNs document and tailor the intervention on the basis of the clients' responses and educate patients about making and keeping appointments and receiving preventive health care, and provide contact information for future questions. After ED discharge, PNs follow up with patients in 3 to 10 days.	12 and 24 mo after start of program	Odds of postintervention PCR-ED visit, total mean ED visits, and cost per person (intervention delivered at 1 ED, outcomes tracked at 9 EDs).	Those with ≥1 or ≥2 PCR-ED visits in 12-mo preperiod in both intervention and comparison groups had significant reductions in PCR-ED use at 12 mo (range 26.9%–46.4%). All patients in both intervention and comparison groups had significantly fewer PCR-ED visits comparing 24 mo preintervention to 24 mo postintervention.		Intervention paid for itself based on PCR-ED visit reductions in intervention group: unclear how costs defined.	Low

Table E2. Continued.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
Goodman, 2013	Health plan members w/$50 ED copay	Members w/ primary care physicians in qualifying practice: at least 1 PCP w/ ≥100 health plan members, ≥30 members w/same copay, w/ 3-y preinter-vention trend in worsening ED visit rates, 11 PCPs (I): N=914 in year 1, decreas-ing to 421 in year 4	Members w/non-participating primary care providers, w/ either improving or no trend in ED visit rates, 15 PCPs (UC): N=702 in year 1, decreasing to 273 in year 4	Time series, non-equivalent comparison groups, no statistical testing	2007–2010	Detroit, MI	(1) Guidelines for triaging patients over the telephone and scripts for recorded messages to direct patients to the appropriate care provider; (2) a welcome letter on how to handle an acute but minor illness or injury when their PCP is not available; (3) a follow-up letter to patients with recent visits to the ED; (4) protocols for office scheduling to allow same-day appointments (including evenings and weekends); intervention included education of all intervention PCP offices, and materials were customizable to individual offices; sites varied in types of elements that were implemented	4 mo postintervention, compared to the same calendar mo in the 3 y preintervention	ED visits for PCP-treatable conditions (health plan admin-istrative data)	ED visits/1,000 members decreased in the 1 y postinter-vention: (I) 49.2 (pre) to 7.3 (post), compared to (UC) 21.9 (pre) vs 23.8 (post), but no testing of stat. significance for overall trends. (Note that because of selection, comparison group had considerably higher rates at start of observation period and experienced large declines in use before intervention year.)					Very low
Scherer, 2010	Medicaid and uninsured patients without primary care provider, discharged from ED	Identified in ED, referred to the study site FQHC, N=520; ED visit analyses on (1) those with initial follow-up in FQHC, 17.9% (I1) N=93;	(1) Patients referred to FQHC but did not follow up; (2) patients who did not establish an ongoing relationship w/FQHC	Post only, nonequiva-lent comparison groups, multivariate analysis adjusting for demo-graphic and clinical factors	2004–2006	St. Louis, MO	(I) ED partnership with FQHC (with 5 clinic sites) for referrals: emergency physician recommended referral; on discharge, patients given printed instructions with contact info of clinic site and time	2 y postintervention	Any subsequent ED visit, mean number of ED visits (single hospital records)	No signif. diff. in ED visits between patients w/ initial follow-up and those without: (I1) 1.9 (SD 3.8) vs (UC) 1.8 (SD 3.6) *P*=.85; no signif. diff. betw. those w/ongoing relationship					Low

		(I2) those with ongoing relation-ship w/ FQHC, 7.1% (I) N=37					range for follow-up, 3 tiers: R1: next day, R2: next week, R3-2–3 wk, R4 as needed; R1/R2 referrals: case manager faxed information FQHC, and FQHC staff contacted patients 1 day postdischarge; secondary analyses (I1): patient completed follow-up to FQHC; (I2) patient established ongoing relationship w/ FQHC, defined as ≥1 FQHC visits/y after intervention			w/FQHC and those without in adjusted analyses				
Retchin, 2009	Adults, Virginia Indigent Care Program (<200% FPL, asset test), greater Richmond area, uninsured	Identified in ED, success-fully trans-ferred care to PCPs, continu-ously enrolled 1 y, N=2,389 (program turnover 50%/y)	Participants serving as own controls	Pre-post analysis	2001–2003	Richmond, VA	Managed care program developed by hospital and community practices w/ sliding scale fees, copays, monthly management fees. Outreach workers recruit from ED, refer to PCP, schedule appointments, arrange transportation, provide info on community social services, coordinate between primary and specialty care; nurse care coordinators answer health care questions, reinforce treatment plans, assist w/ navigation	2 y postintervention	ED visits (single hospital records)	No signif. diff. in any ED visits postinter-vention; time series analysis: no diff. in ED visits per member per month postenroll-ment	Hospitalizations, primary care and specialty care visits per member per month/1,000 enrollees (claims data)	No signif. diff. in inpatient discharges or specialty care visits before vs after enrollment in program; increase in primary care visits before, 51.2; after: 130.8.	Costs: payment and manage-ment fees to primary care providers converted to pmpm (from claims)	Total payments to PCPs increased from $320,128 to $1,323,808 from first to third year; management costs increased from $5 pmpm to $7 pmpm from 2003–2007.	Very low
Barksdale, 2014	ED patients with	381 patients from	Nonequivalent comparison	Retrospective chart review	2008–2009	Kansas City, MO	Retrospective review of	6-mo follow-up after index ED visit for	Return ED visits	No significant difference in	Return ED visits for the subset of	No significant difference		Low

Table E2. Continued.

Source	Target Population	Sample	Comparison Group	Study Design	Study Period	Location	Program Activities	Evaluation Period	ED Use		Other Outcomes		Costs		Study Quality
									Measure	Findings	Measure	Findings	Measure	Findings	
	low-risk chest pain provided with a 72-h cardiology follow-up appointment	single ED provided with appointment	group of patients who did not keep their scheduled cardiology follow-up appointment				patients with chest pain, discharged from the ED with a scheduled cardiology clinic appointment	low-risk chest pain	for chest pain	ED revisits for chest pain among patients who attended cardiology appointments compared with those who did not	patients who underwent cardiac testing as a result of the cardiology appointment and those who did, factors associated with keeping cardiology appointments	between patients who did and did not undergo testing. Factors associated with attending follow-up appointment included having commercial insurance.			
Financial penalties															
Hartung, 2008	Medicaid adult enrollees, presumably OHP-S; subanalyses on members with chronic conditions: depression, schizophrenia, respiratory disease, cardiovascular disease, and diabetes	OHP Standard, managed care enrollees excluded; chronic disease cohorts: *ICD-9* codes from claims	Preintervention month (historical trend comparison)	Time series, segmented regressions adjusted for aggregated demographic and comorbidity characteristics	2001–2004	Oregon	(See above, Lowe, 2010) With an emphasis on pharmacy copayments and drug exclusions	12 mo pre/24 mo post for entire sample, 12 mo for chronic disease cohorts	ED visit rates/100 members per month, change in postintervention monthly trend in ED visits (claims data, excluding managed care)	No signif. changes in ED use; no signif. change in trend of use; no signif. changes in ED use among diabetes cohort (other cohorts not reported)	Hospitalizations, office visits, number of prescriptions, all per 100 members/month	Positive trend in hospitalizations (0.04 phmpm, 95% CI 0.01 to 0.07). No signif. changes for office visits; use of all Rx decreased 17.2% (95% CI 20.7% to −13.6%), declines also signif. for chronic disease cohorts	Not studied		Low
Lowe, 2008	Former OHP-S enrollees, now uninsured	Purposive sample of 26 EDs in Oregon, representing urban and rural areas	Preintervention month (historical trend comparison)	Time series, adjusted for calendar month and secular trends; secondary individual-level analyses on probability of hospitalization, adjusted for age, sex, secular trends	2002–2005	Oregon	(See above, Lowe 2010) Policy changes triggered mass disenrollment from OHP, ie, "intervention" of interest is selected reduction in population covered by Medicaid.	24 mo pre/24 mo post	Total number of ED visits/month per payer class (claims data)	Postpolicy change: ED adjusted visit/month rate for uninsured increased 20% (95% CI 13% to 28%), net of secular trend of 7% annually. OHP: rates decreased 20% (95% CI −14% to −25%), net a secular trend of 5% annual increase. Commercially insured: decreased; Medicare: decreased, indicators for OHP changes not signif.	ED visits leading to hospital admission, psych-, drug-,alcohol-related ED visits (claims data)	Odds of ED visit leading to hospitalization: (Uninsured) AOR 1.5 (95% CI 1.39,1.62); (OHP) AOR 1.09 (1.03,1.16). Rates of psych/drug/alcohol-related visits to ED: increased among uninsured, decreased among OHP members	Not studied		Very low