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Authors
Korenstein, Deborah
Duan, Kevin
Diaz, Manuel J
et al.

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Do health care delivery system reforms improve value? The jury is still out

Deborah Korenstein[1], **Kevin Duan**[2], **Manuel Jose Diaz**[2], **Rosa Ahn**[3], and **Salomeh Keyhani**[3,4]

[1] Department of Medicine, Memorial Sloan Kettering Cancer Center, New York, NY

[2] Department of Medicine, University of California San Francisco, San Francisco, CA

[3] San Francisco VA Medical Center, San Francisco, CA

[4] Division of General Internal Medicine, University of California San Francisco, San Francisco, CA

Abstract

Background—Widespread restructuring of health delivery systems is underway in the US to reduce costs and improve the quality of healthcare.

Objective—To describe studies evaluating the impact of system-level interventions (incentives and delivery structures) on the value of US healthcare, defined as the balance between quality and cost.

Research Design—We identified articles in PubMed (2003 to July 2014) using keywords identified through an iterative process, with reference and author tracking. We searched tables of contents of relevant journals from August 2014 through 11 August 2015 to update our sample.

Subjects—We included prospective or retrospective studies of system-level changes, with a control, reporting both quality and either cost or utilization of resources.

Measures—Data about study design, study quality, and outcomes was extracted by one reviewer and checked by a second.

Results—Thirty reports of 28 interventions were included. Interventions included patient-centered medical home (PCMH) implementations (n=12), pay-for-performance programs (n=10), and mixed interventions (n=6); no other intervention types were identified. Most reports (n=19) described both cost and utilization outcomes. Quality, cost, and utilization outcomes varied widely; many improvements were small and process outcomes predominated. Improved value (improved quality with stable or lower cost/utilization or stable quality with lower cost/utilization) was seen in 23 reports; 1 showed decreased value, and 6 showed unchanged, unclear or mixed results.

Study limitations included variability among specific endpoints reported, inconsistent methodologies, and lack of full adjustment in some observational trials. Lack of standardized MeSH terms was also a challenge in the search.

Corresponding author: Deborah Korenstein MD, FACP, Memorial Sloan Kettering Cancer Center, 1275 York Avenue, New York, NY 10065, Tel: (646) 888-5119, Fax: (646) 227-7102.

Conclusions—On balance the literature suggests that health system reforms can improve value. However, this finding is tempered by the varying outcomes evaluated across studies with little documented improvement in outcome quality measures. Standardized measures of value would facilitate assessment of the impact of interventions across studies and better estimates of the broad impact of system change.

Keywords

Care delivery system; quality of care; cost containment

INTRODUCTION

In the United States, approximately one fifth of spending is dedicated to health care. Recognition of lack of transparency, fragmentation, and the poor return for high spending has led to broad agreement about the need for fundamental change in the US health care system to both lower costs and improve quality. The concept of improving "value" has emerged to frame needed reforms.[1,2] Value can be understood as the balance between care quality (in terms of patient satisfaction and health outcomes) and expenditures, though specific definitions vary among stakeholders.[2,3]

By 2013 several national policy organizations had proposed reforms to promote structural change and improve value in health care delivery.[4] While some have questioned the likely impact of these interventions[5], medical homes, value based purchasing, and pay-for-performance programs were endorsed consistently across organizations, leading government, insurers, and health plans to incentivize these strategies to improve value. Such efforts have led to demonstration and pilot projects with a rapidly expanding literature describing interventions and their outcomes. Early reports suggest that pilot project interventions have led to improvements in quality while reducing spending.[6]

To enhance our understanding of the potential impact of structural reforms on the health care system, we performed a systematic review of the effect of system-level interventions on the value of health care in the U.S. and present descriptions of relevant studies.

METHODS

Overview

We performed a systematic review of system-level US interventions which reported the components of value. We used the PRISMA statement on systematic reviews of studies reporting health care interventions[7] to guide the methods. We defined system-level interventions as those that broadly altered either payment methods (e.g. pay-for-performance) or health care delivery structure (e.g. the patient-centered medical home model).

Framework for "value"

Definitions of value vary based on stakeholder.[2] While different health systems establish variable thresholds for determining the cost-effectiveness of interventions[8], all would agree

that improved outcomes at fixed or lower cost represent improved value. We included papers assessing both quality of care (including patient satisfaction) and either the cost of care or health services utilization, which is often used as a proxy for cost.[9] We conceptualized value as the balance between quality and cost or utilization, defining value improvement as better quality with lower or constant cost/utilization.

Study identification and data extraction

We conducted a MEDLINE search (PubMed interface) for studies published from January 1, 2003 through July 23, 2014, limited to human subjects, English language, and titles with abstracts. We used an iterative process to identify search terms (Figure 1) and identified additional articles through author and reference tracking. To update our results, we searched tables of contents of relevant journals published between August 1, 2014 and August 11, 2015, for articles potentially meeting inclusion criteria. See Supplementary Digital Content for details of study identification and data extraction.

We included controlled studies evaluating the impact of system-level interventions on value in general clinical environments (e.g. physician's offices, hospitals). All papers were reviewed by 1 investigator (MJD, KD, DK, SK). A random sample of 296 full-text articles were reviewed by one of two pairs of investigators for determination of interrater reliability (Cohen). Figure 2 demonstrates the flow of articles in the review.

Data extraction was performed by one reviewer (RA, KD, MJD, DK, or SK) and checked by a second reviewer (RA or DK) for accuracy. Differences were resolved by discussion and consensus.

Assessment of Study Quality

We collected information related to study quality using applicable components of the Cochrane risk of bias tools for cohort and randomized studies.[10,11] For randomized trials we recorded the completeness of follow-up and whether the randomization method was described[10]; for observational studies we recorded whether confounders were assessed and whether adjustments were made for confounders.[11]

Determination of Value

We defined increased value as either 1) increased quality with no change or reduction in cost/utilization or 2) no change in quality with lower cost/utilization. We defined decreased value as 1) reduced quality with no change or increase in cost/utilization or 2) no change in quality with an increase in cost/utilization. Changes were defined as marginal when only one of multiple reported measures was significantly changed. We defined value as unchanged if both quality and cost/utilization were unchanged. We defined value as mixed when reported measures of quality or cost/utilization changed in opposite directions (e.g. two quality measures were reported, with one improving and one worsening) or when both quality and cost/utilization increased or decreased. While we recognize that some definitions of value (e.g. those based on cost-effectiveness) would allow for determinations of value in situations we deemed “mixed” such as when both quality and cost increase, cost-effectiveness and

relevant thresholds are rarely reported. We defined value as unclear when the data presented were insufficient to draw conclusions (e.g. statistical significance not reported).

Data Analysis

Interrater reliability for the decision to include the article in the review was moderate to high (Cohen , 0.83 and 0.58 for the two investigator pairs). Given differences in interventions, study populations, study designs, and outcome measures, we did not attempt to pool study results; instead we present descriptive information.

RESULTS

Our initial search yielded 10,960 articles; 10,664 were excluded in title and abstract review. Including the updated search, 29 articles describing 29 studies of 28 interventions were included in the review (Figure 2). One article described 2 interventions and 3 articles described 2 studies of 1 intervention (the 3 articles all presented unique data and are listed separately, resulting in 30 reports described in Tables 1 and 2).

Characteristics of included studies

Table 1 describes study characteristics of the 30 separate included reports. 14 interventions were primarily PCMH implementations,[9, 12-23] 10 were pay-for-performance programs[24-33], and 6 were mixed with features of both intervention types.[334-39]

Study quality varied. There was one randomized trial[37]; the method of randomization, drop-outs, and follow-up were well described. Among the remaining observational studies, 22 adjusted fully for confounding factors, 5 performed partial adjustment, and 2 did not adjust for confounders.

Impact of interventions on quality

Reported quality indicators varied widely (Table 2) and most studies reported multiple quality outcomes (predominantly process measures). The most commonly reported outcome was the rate of hemoglobin A1C testing in diabetic patients (14 studies), followed by lipid testing rates (14 studies), cancer screening rates (11 studies), readmission rates (7 studies), composite quality measures (5 studies), patient satisfaction (5 studies), and diabetes control (5 studies). Measures of overuse were reported in 2 studies; a PCMH intervention reported unnecessary imaging for low back pain[13] and a pay-for-performance intervention reported unnecessary pharyngitis testing [26]; rates of overuse declined in both. Mortality was reported in one study of a pay-for-performance intervention[30] and did not decline significantly in the intervention group.

Overall, 17 studies found net improvement in quality (though often some measures were unchanged or reduced), 5 found marginal improvement, 3 found no change, 1 found marginal decline in quality, 1 found no change, and 3 had unclear results (Table 2).

Impact of interventions on cost and utilization

Most reports (n=19) described both cost and utilization outcomes; 5 reported only cost and 6 reported only utilization (Table 2). Specific cost and utilization outcomes varied widely. Utilization outcomes generally focused on rates of outpatient visits, emergency department visits, and hospitalization. Several studies reported total cost per beneficiary over a defined time period.

Impact of interventions on value

There were 30 reports from which we summarized the impact on value (Table 2). Value was improved in 17, marginally improved in 6, marginally lower in 1, unchanged in 1, and unclear or mixed in 5. Given the variability in specific outcome measures, direct comparisons of the impact of different interventions on value cannot be made.

DISCUSSION

In this systematic review, we describe system-level interventions for which value-relevant outcomes have been reported. Interventions included PCMH implementations, pay-for-performance initiatives, and programs with features of both. We found wide variability in study quality and reported outcome measures. The limited available evidence suggests that PCMH and pay-for-performance initiatives improve value, but the magnitude and importance of this improvement is not clear.

We defined value loosely for the purposes of this review, crediting improved value when improvements in quality, cost, or utilization were very small, clinically trivial, or limited to patients with specific diagnoses. This approach likely overestimated value improvements. We opted to loosely define value so our findings will reflect the majority of published studies of system interventions so far. However, given the importance of optimizing value, it will be critical for future studies to measure outcomes that facilitate meaningful value calculations and to include broad patient populations. Further, as experts attempt to estimate the impact of care delivery innovations across the US healthcare system, thresholds for important changes in value will need to be established.

Quality is an important driver of value but some quality outcomes are more meaningful than others. We credited “marginal” quality improvement when at least one of many measures improved, which may have overestimated value improvements. If we applied a more stringent definition of improved value, requiring improvement in at least 2 quality measures, the majority of studies (17/30) still found that value improved. However, most reported quality outcomes involved process measures (e.g. the proportion of diabetic patients in whom HbA1C was checked) and not outcome measures (e.g. improvements in HbA1C values). There were few changes in measures of clinical outcomes; indeed none of the most recent studies (published in 2014 or 2015) found improvements in outcome measures; 3 evaluated no outcome measures and 4 included them but found that they did not improve. This failure to impact outcome measures is important. While process measures can predict meaningful patient outcomes[40, 41], their association with clinical improvements may be limited [42] and they may poorly reflect population health[43]. Further, observed quality

improvements were often of small magnitude (Table 2). The clinical importance of these changes is unclear; assessment of true clinical outcomes rather than process measures would facilitate a richer understanding of the impact of system level interventions.

Cost outcomes were similarly heterogeneous. Among the 8 highest quality studies, only 3 found lower cost, each using a different approach to measure costs. And it is notable that these assessments did not include costs associated with practice transformation or incentive payments. Standard cost measures are needed to facilitate direct comparison and estimation of the likely impact of larger-scale interventions. Several studies measured cost as total dollars spent per patient per month; this seems the most appropriate standard for use in future studies.

It is notable that only two evaluations in our review addressed overuse, which contributes to both poor quality and higher costs[44]. Both studies found a reduction in overuse. However, the exclusion of overuse outcomes from the majority of studies is problematic since it is important that system-level interventions successfully minimize overuse.

Our study has important limitations. Since utilization is a proxy for cost, we included studies which measured utilization and not cost. However, utilization may be a poor measure of cost[45]. In addition, we did include cost-effectiveness when conceptualizing value; indeed cost-effectiveness was not reported in any identified studies and was beyond the scope of these studies. Limiting our review to studies evaluating cost-effectiveness would have limited its scope. However, attention to cost-effectiveness will be critical to more nuanced future assessments of value. Further, there are no specific MeSH terms for health care value so our search may have failed to identify studies. However, extensive reference and author tracking make it unlikely we missed large important studies. Finally, we focused primarily on value, for which there is no standard calculation method. Our intentionally liberal approach is meant to be descriptive and may have overestimated the impact of interventions.

In conclusion there is a small emerging body of literature on PCMH and pay-for-performance interventions that suggests that these interventions may to some extent improve value. However despite the broad nation-wide movement toward these system-level reforms we found only 30 assessments of their impact on value. Further, studies to date are methodologically limited and the diversity of specific measures precludes direct comparisons among interventions. Standardization of the definition of value and the measures used to assess value and replication of our findings under more standardized conditions are critical for optimizing the evidence base to inform system-wide change.

Acknowledgments

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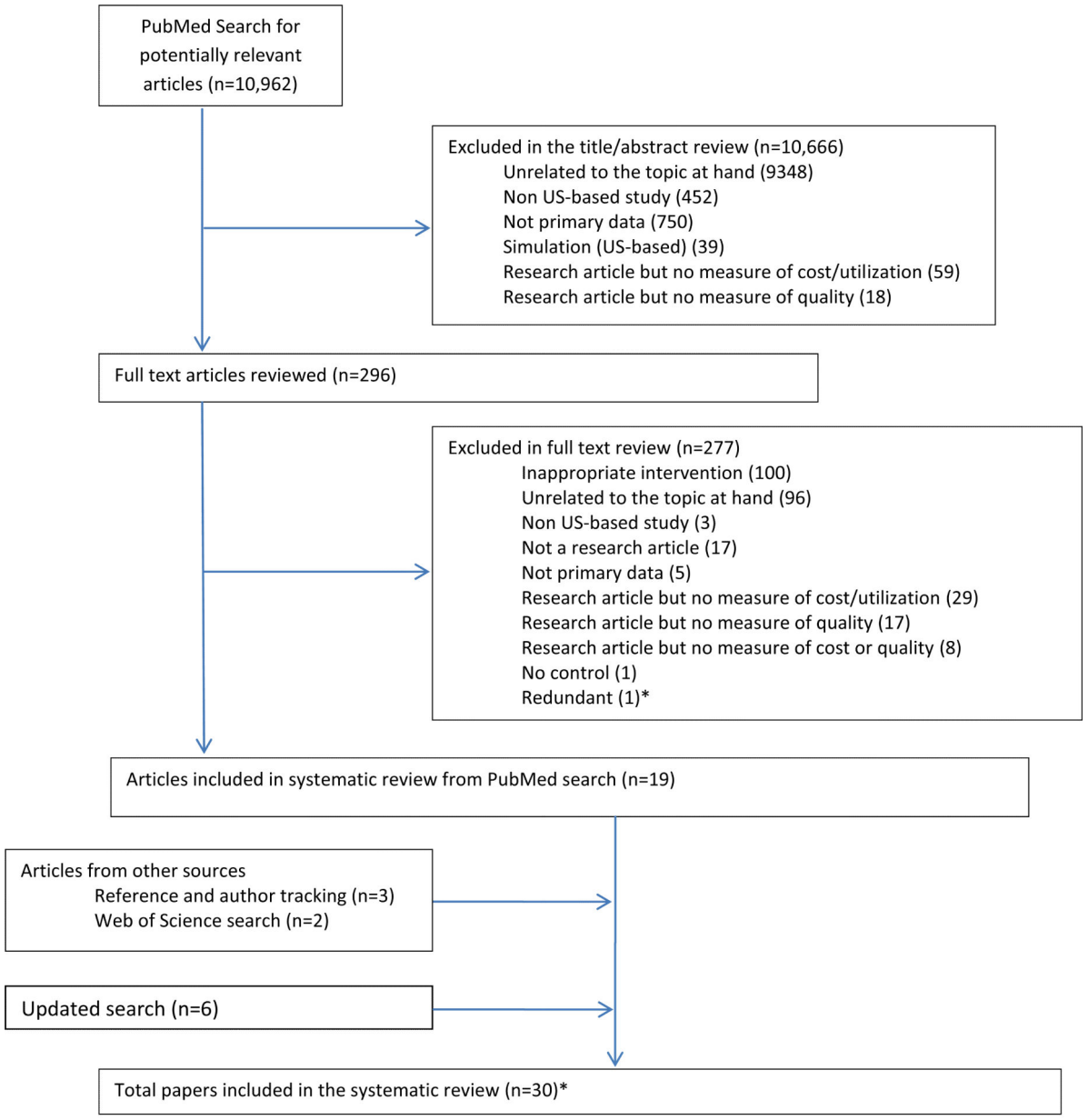
1. Reimbursement, incentive [Mesh]
2. Value based purchasing [Mesh]
3. Physician Incentive Plans [Mesh]
4. "Cost Savings/statistics and numerical data"[Majr]
5. Accountable Care Organizations [Mesh]
6. "Risk Sharing, Financial/economics"[Mesh]
7. (("Pilot Projects"[Mesh]) AND "Quality of Health Care"[Mesh]) AND "Program Evaluation"[Mesh]
8. ("Health Care Costs"[Mesh]) AND "Patient-Centered Care"[Mesh]
9. (("Health Care Costs/organization and administration"[Mesh] OR "Health Care Costs/statistics and numerical data"[Mesh] OR "Health Care Costs/trends"[Mesh] OR "Health Care Costs/utilization"[Mesh])) AND "Quality of Health Care"[Mesh]
10. ("utilization" [Subheading]) AND ("Quality of Health Care/mortality"[Mesh] OR "Quality of Health Care/statistics and numerical data"[Mesh] OR "Quality of Health Care/trends"[Mesh] OR "Quality of Health Care/utilization"[Mesh])

Figure 1.
Terms Used in Search



*Excluded Song 2011 because same data reported in Song 2012

**Three papers reported the same study but with different subpopulations (Reid 2010, Fishman 2012, Liss 2013). One paper (Raskas 2012) reported 3 studies, 2 of which met our inclusion criteria. In all there were 30 reports of 28 unique studies.

Figure 2.
Flow of articles in the review

Table 1

Characteristics of included studies

Author, year	Project name (if identified)	Clinical site	Population studied	Study design	Adjustment for confounders	Intervention group sample	Control group sample	Follow up time
Patient Centered Medical Home Interventions (PCMH)								
Kaushal 2015[22]		Primary care	Patients under the care of physicians from multiple health plans in NY State	Pre-post/concurrent comparator	Full	92 physicians	183 physicians	1 year
Van Hasselt 2015[23]		Primary care	All Medicare FFS[*] patients seen in participating clinics	Pre-post/concurrent comparator	Full	308 practices	1906 practices	2 years
Friedberg 2014[15]	Southeastern Pennsylvania Chronic Care Initiative (PACCI)	Primary care	All patients seen in participating clinics	Pre-post/ concurrent comparator	Full	64243 patients	55959 patients	3 years
Christensen 2013[12]		Primary care	All patients seen in participating clinic	Pre-post/ concurrent comparator	Full	4090 patients[†]	4090 patients[†]	1.5 years
Hochman 2013[16]		Primary care	All patients seen in resident clinic	Pre-post/ concurrent comparator	Full	4679 patients[≠]	8899 patients[≠]	1 year
Liss 2013[17§]	Group Health	Primary care	Adults with diabetes, CHD, or hypertension	Pre-post/ concurrent comparator	Full	1181 patients	36757 patients	2 years
Rosenthal 2013[9]	RI Chronic Care Sustainability Initiative	Primary care	All patients seen in participating clinics	Pre-post/ concurrent comparator	Full	31130 member months	14779 member months	2 years
Werner 2013[21]		Primary care	Horizon Blue Cross Blue Shield patients	Pre-post/ concurrent comparator	Full	10004 patients	25055 patients	1 year
Devries 2012[13]		Primary care	Patients under 65 years	Retrospective concurrent comparator	Full	31032 patients	350015 patients	1-2 years
Fishman 2012[14§]	Group Health	Primary care	Patients 65 and older	Pre-post/ concurrent comparator	Partial	1415 patients[‖]	1415 patients[¶]	2 years
Raskas 2012[18i**] - CO	CO Multipayer PCMH	Primary care	Well point-affiliated plan members	Pre-post/concurrent comparator	Partial	6,200 patients		2 years
Raskas 2012[18**] - NH	NH Citizens Health Initiative Multi-Stakeholder[††]	Primary care	Wellpoint-affiliated plan members	Pre-post/ concurrent comparator	Partial	10,000 patients		15 months
Rosenberg 2012[20]		Primary care	All patients seen in	Pre-post/ concurrent comparator	Full	23900 patients	Not stated	2 years

Author, year	Project name (if identified)	Clinical site	Population studied	Study design	Adjustment for confounders	Intervention group sample	Control group sample	Follow up time
			participating clinics					
Reid 2010[19]	Group Health	Primary care	All patients seen in participating clinic	Pre-post/concurrent comparator	Partial	7018 patients	200970 patients	2 years
Pay for Performance Interventions								
Lemak 2015[32]	Physician Group Incentive Program	Primary care, Specialty	Blue Cross Blue Shield of MI patients	Pre-post/concurrent comparator	Full	7774 practices	2991 practices	2-3 years
McWilliams 2015[33]	Pioneer ACO		Random sample of FFS Medicare patients	Pre-post/concurrent comparator	Full	201,644 (post) - 566,410 (pre) patients	4.8 million (post) -14.2 million (pre) patients	1 year
Chien 2014[26]	Alternative Quality Contract	Primary care	Blue Cross Blue Shield of MA HMO pediatric patients	Pre-post/ concurrent comparator	Full	126975 patients	415331 patients	2 years
Esse 2013[28]		Primary care	Medicare Advantage patients	Cross-sectional analysis	Full	1225 patients	3015 patients	1 year
Calikoglu 2012[24]	Quality-Based Reimbursement Program	Hospital	Medicare patients	Retrospective concurrent comparator	Full	~700,000 discharges annually	Details not specified	3 years
Colla 2012[27]	Medicare Physician Group Practice Demonstration	Primary care	Medicare patients	Retrospective concurrent comparator	Full	990,177 patients	7514453 patients	5 years
Song 2012[31]	Alternative Quality Contract	Primary care	Blue Cross Blue Shield of MA patients	Pre-post/ concurrent comparator	Full	428892 patients	1339798 patients	2 years
Chen 2010[25]		Primary care	Patients with diabetes	Concurrent comparator	Full	30617 patients‡‡	1748 patients§§	3 years
Leitman 2010[29]		Hospital	Inpatient admissions to 1 hospital	Pre-post/concurrent comparator	None	29535 patients	20360 patients	3 years
Ryan 2009[30]	Premier Inc./CMS Hospital Quality Incentive Demo	Hospital	Medicare patients with AMI, HF, pneumonia, or CABG	Concurrent comparator	Full	256 PHQID hospitals	3077 control hospitals///	6 years
Mixed interventions								
Friedberg 2015[39]	Northeastern Pennsylvania Chronic Care Initiative (PACCI)	Primary care	All patients seen in participating clinics	Pre-post/ concurrent comparator	Full	27 practices	29 practices	3 years
Fifield 2013[37]		Primary care	Patients seen in participating clinics	RCT	NA	18 practices	14 practices	2 years

Author, year	Project name (if identified)	Clinical site	Population studied	Study design	Adjustment for confounders	Intervention group sample	Control group sample	Follow up time
Claffey 2012[36]		Primary care, specialty	Medicare Advantage patients	Concurrent comparator	None	750 patients	Not stated	3 years
Salmon 2012[38]	Collaborative Accountable Care Initiative	Primary care, multispecialty	Cigna Health patients	Concurrent comparator	Partial	3 practices		1 year
Fagan 2010[35]		Primary and multispecialty	Elderly patients with diabetes	Pre-post/concurrent comparator	Full	1587 patients	19356 patients	1 year
Gilfillan 2010[34]	Proven Health Navigator	Primary care	Medicare Advantage patients	Pre-post/ concurrent comparator	Full	8634 patients	6676 patients	Up to 4 years

*FFS=fee for service

†Not fully reported; Quality outcomes based on survey of 4090 patients from combined intervention and comparator sites

‡Numbers differed from pre- to post-; these are the post-intervention numbers

§Studies describe different outcomes from the same intervention ‖1415 patients for quality outcomes and 1947 for utilization outcomes

¶130067 patients for quality outcomes and 39396 for utilization outcomes

**Includes three pilots; however two (CO and NH) are reported because the third site (NY) had only baseline data available

††Full name is: NH Citizens Health Initiative Multi-Stakeholder Medical Home Pilot

‡‡Changed over time; 30617 patients in the final year

§§Numbers changed over time; 1748 patients in the final year

‖‖3077 control hospitals (118 eligible nonparticipating hospitals and 2959 noneligible hospitals)

Table 2

Results of included studies: quality, utilization, cost and value.

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
Friedberg 2015[39]	**Improved:** Breast cancer screening (5.6% difference); Diabetes care: HbA1C testing (8.3% difference), LDL testing (8.5% difference), nephropathy testing (15.5% difference), eye examinations (12.0% difference) **Unchanged:** Colorectal cancer screening ***No outcome measures***	5/6 improved 1/6 unchanged	**Decreased** (rate per 1000 patients/month): Hospitalizations (difference 1.7), ED visits (difference 4.7), specialty visits (difference 17.3) **Increased:** primary care visits (77.5)	4/5 decreased 1/6 increased (desired change)	Not Reported	Not Reported	Increased
Kaushal 2015[22]	**Unchanged:** Readmissions ***Outcome measure included but unchanged***	No Change	**Decreased:** specialty visits (difference of 21.4/100 patients) **Unchanged:** Primary care visits, diagnostic tests, lab tests, admissions	1/6 decreased 5/6 unchanged	Not Reported	Not Reported	Marginal Increase *
Lemak 2015[32]	***Only early participants vs. nonparticipants reported*** **Improved:** Breast cancer screening (1% difference), adolescent well care (18.2% difference) and immunization (23.9% difference), child immunization (2.8% difference), well child visit 3-6 years (11.6% difference), **Diabetes care:** lipid therapy (1.7% difference), testing for HbA1c (3.2% difference), LDL	11/14 increased 3/14 unchanged	Not Reported	Not Reported	**Decreased:** Total spending: adult patients (−1.1%), pediatric patients (−4%)	Decreased	Increased

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
	(2.1% difference), nephropathy (2.2% difference), ACE inhibitors for: nephropathy (4.6% difference), hypertension (1.7% difference) **Unchanged:** Cervical cancer screening, well child visit 0-15 months, ACE inhibitors in patients with HF ***No outcome measures***						
McWilliams 2015[33]	**Improved:** Preventive services for patients with diabetes: HbA1c testing (0.5% difference), LDL testing (0.5% difference), retinal examination (0.8% difference), receipt of all 3 (0.8% difference) **Unchanged:** 30 day readmissions, mammography in women aged 65-69 ***Outcome measure included but unchanged***	1/3 increased 2/3 unchanged	**Unchanged:** hospitalizations for ambulatory care sensitive conditions	No Change	**Decreased:** quarterly per-beneficiary spending (difference $29.20)	Decreased	Increased
Van Hasselt 2015[23]	**Unchanged:** 30 day readmissions (overall and amb care sensitive) ***Outcome measure included but unchanged***	No Change	**Decreased:** ED visits: overall (difference 54.8 per 1000 patients), amb care sensitive conditions (difference 13.4 per 1000 patients) **Unchanged:** hospitalizations, primary care visits, specialist visits	1/5 decreased 4/5 unchanged	**Decreased:** total Total payments (difference $265), hospital payments (difference $165) **Unchanged:** payments to outpatient department, home health, hospice, physicians	2/6 decreased 4/6 unchanged	Increased

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
Chien 2014[26]	**Improved:** Composite of 6 HEDIS metrics: difference in difference 2.4% for special needs children and 1.9% for usual needs children; child/ adolescent well visits, chlamydia screening; pharyngitis testing, upper respiratory infection treatment **Unchanged:** Infant well visits and all measures NOT tied to P4P ***No outcome measures***	Measures tied to P4P: 6/7 improved 1/7 unchanged	**Unchanged:** ED visits for persistent asthma†	No Change	**Unchanged:** Average per capita annual medical spending	No Change	Increased
Friedberg 2014[15]	**Improved:** Nephropathy monitoring (5.6 to 16.3 by year3) **Unchanged:** Breast cancer screening; diabetic eye exam; HbA1C testing; HbA1C abnormal; LDL testing; LDL abnormal; cervical cancer, chlamydia, and colorectal screen, appropriate asthma appropriate medication ***Outcome measures included but unchanged***	1/11 improved 10/11 unchanged	**Unchanged:** Primary care visits, specialty visits, ED visits, amb care sensitive ED visits, admissions, hospitalizations	No Change	**Unchanged:** Adjusted dollar per 1000 patients per month unchanged	No Change	marginal Increase
Christensen 2013[12]	**Improved:** Patient satisfaction (0.78 to 0.82) **Significance not stated for:** HbA1C testing, HbA1C>9 LDL screening, LDL <100, Pap smear testing, Asthmatics, Mammography	1/9 increased 8/9 significance not stated	Significance not stated for: Primary care visits, Specialty visits, ED visits, Admi ssions, Length of stay	Unclear	Significance not stated: total costs (9% reduction) and Pharmacy/ ancillary costs	Unclear	marginal Increase

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
	screening, Colorectal cancer screening ***Outcome measures included; change unclear***						
Esse 2013[28]	**Improved**[§]: LDL-C screen (OR 1.425), A1C testing (OR 1.468), % measured creatinine (OR 1.891), % measured microalbumin (OR 2.319), Flu vaccination (OR, 1.383) ***No outcome measures***	Increased	Unchanged: ER visits, acute admits	No Change	Not Reported	Not Reported	Increased
Fifield 2013[37]	**Improved:** Breast cancer screening (+3.5% vs −0.4% in control), hypertensive BP Control (+23.2% vs. −1.9%) **Unchanged:** Lipid screening in CV disease and diabetes, Nephrology screening, Chlamydia screening, Diabetic HbA1C testing, Lipid Control in CV disease and diabetes, diabetic BP Control, HbA1C Control ***Outcome measures included; ¼ improved***	2/11 increased 9/11 unchanged	Decreased: ED Visits (ratio −0.7% vs +0.5 in control group) Unchanged: ED Efficiency and Hospital Adm Efficiency Indices, Hospital Admissions	1/4 decreased 3/4 no change	Total costs, ED, hospital admin, outpatient costs unchanged	No Change	Increased
Hochman 2013[16]	Patient satisfaction improved (0.64 to 0.8) ***No outcome measures***	I ncreased	Increased: Admissions (25 to 27) Unchanged: ED visits, total ED or hospital use	1/3 increased 2/3 no change	Not Reported	Not Reported	Mixed

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
Liss 2013[17‡]	**Improved:** DM: A1C testing (RR 1.01), A1C <9% (RR 1.03), CHD: LDL<100 mg/dL (RR 1.11), DM: A1C% (RR −0.15), CHD: LDL (RR −2.20) **Unchanged:** BP<140/90, systolic BP, CHD: LDL screening ***Outcome measures included; 3/5 improved***	5/8 improved 3/8 unchanged	Decreased: Ambulatory care sensitive hospitalization (RR 0.59), total inpatient admissions (RR 0.76), Urgent care (RR 0.85), primary care visits (RR 0.93) Unchanged: Specialty care visits	3/5 decreased 2/5 no change	Decreased: Total monthly per member cost (RR 0.83)	Decreased	Increased
Rosenthal 2013[34]	**Unchanged:** HbA1C testing, Lipid testing, Diabetic eye exam, Colon, breast, and cervical cancer screening ***No outcome measures***	No Change	Decreased: Amb care sensitive ED visits (RR 0.75) Unchanged: Admissions, Amb care sensitive admissions, primary care and specialty visits, ED visits, # of prescriptions, prescription days	1/8 decreased 7/8 no change	Not Reported	Not Reported	marginal Increase
Werner 2013[21]	**Improved:** Mammogram screening (difference in differences +0.022)[§] **Decreased:** Nephropathy screen (difference in differences −0.066)[§] **Unchanged:** A1C testing, eye exam, LDL screen, Colon cancer screen, 30 day readmission, pap smear, chlamydia screening, LDL testing in CV disease ***1 outcome measure; unchanged***	1/10 increased 1/10 decreased 8/10 unchanged	Unchanged: ED visits, admissions	No Change	Payment per member quarter unchanged	No Change	Mixed

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
Calikoglu 2012[24]	**Improved:** Risk adjusted complication rates for 13 conditions Hospital acquired conditions reduced by 15.2% over 2 years ***Outcome measures improved***	Increased	Not Reported	Not reported	Savings from complications (−$110 million)	Decreased	Increased
Claffey 2012[36]	**Significance not stated:** 30-day readmission (33% fewer in intervention) ***Outcome measures; change unclear***	Unclear	Significance not stated: ED visits (11.70% increase), acute admissions (30% reduction), subacute admissions (14% reduction)	Unclear	Significance not stated: Per member per month total (33% decrease)	Unclear	Unclear
Colla 2012[27]	**Improved:** 30-day medical readmission rate (−0.67%), for dually eligible (−1.07%) and nondually eligible (−0.58%), 30-day surgical readmission rate for dually eligible (−2.21%) **Unchanged:** 30-day surgical readmission rate overall and non-dually eligible ***Outcome measures only***	4/6 improved 2/6 unchanged	ED visit rate no change overall, for dually eligible or for nondually eligible participants	No Change	Spending annually per beneficiary mean - savings overall ($496), and among dually eligible ($751) and non-dually eligible ($404)//	Decreased	Increased
Devries 2012[13]	**Improved:** A1C testing in diabetics (0.82 vs. 0.77), LDL screen (0.76 vs. 0.74) and LDL control (0.65 vs. 0.57) in CV disease, imaging for low back pain (0.48 vs. 0.53), appropriate pharyngitis testing (children) (0.97 vs. 0.91), antibiotic	7/13 increased 1/13 decreased 5/13 unchanged	Decreased§: Pediatric hospitalizations (OR 0.77), pediatric ED visits (OR 0.83), adult hospitalization (OR 0.88), adult ED visits (OR 0.88)	Decreased	Total costs per member per month decreased in pediatric (−8.62%) and adult (−14.50%) patients	Decreased	Increased

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
	use in viral URI (children) (0.27 vs. 0.35), long-term controller medications in asthmatics (0.99 vs. 0.98) **Reduced:** Nephropathy care (0.78 vs. 0.81) **Unchanged:** A1C control, LDL screen, LDL control, Eye exams in diabetics, antibiotic use in acute bronchitis (adults) ***Outcome measures included; 1/3 improved***						
Fishman 2012[14]‡	Patient satisfaction **Improved:** ACES - 2/5 measures **Unchanged:** PACIC - 2/2, composite quality ***No outcome measures***	1/2 increased¶	Decreased: Primary care visits (RR 0.93), ED visits (RR 0.79), Amby care sensitive admissions (RR 0.82) Increased: Specialty visits (RR 1.05) Unchanged: Admissions	1/5 increased 3/5 decreased 1/5 unchanged	Total cost per patient per month unchanged	No Change	Marginal Increase
Raskas 2012[18] - CO**	**Significance not stated:** A1c>9%; BP <130/80, Retinal disease, Nephropathy screening, Flu shot, Aspirin therapy, LDL doc, LDL <100 mg/dl, A1c, Rx statins, Queried about tobacco use, and Depression screening increased ***Outcome measures included; change unclear***	Unclear	Significance not stated: acute inpatient admissions decreased; Specialty visits decreased; ED visits increased††	Unclear	Significance not stated: estimated ROI 2.5:1 to 4.5:1)	Unclear	Unclear

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
Raskas 2012[18] - NH**	**Significance not stated:** Quality data unchanged ***Outcome measures unclear***	Unclear	Significance not stated: ED visits decreased	Unclear	Per patient per month cost decreased‡‡	Unclear	Unclear
Rosenberg 2012[20]§§	**Improved:** Readmissions (18.3% decrease vs. 1.4% decrease) **Unchanged:** HbA1C testing, diabetic eye exam, LDL screen, nephropathy monitoring, colon and breast cancer screen, depression management ***No outcome measures***	1/8 increased 7/8 unchanged	Decreased: Admissions (4.4% difference in difference) and ED visits (3.6% difference in difference)	Decreased	Dollars per member per month decreased////	Decreased	Increased
Salmon 2012[38]	**Unchanged:** HbA1C testing, serum Creat in HTN, LDL testing, mammogram, nephropathy screening in diabetes ***No outcome measures***	No Change	Not Reported	Not Reported	Total cost in dollars per patient per month in AZ ($27.04 savings)† Total cost in NH and TX u ncha nge d	1/3 sites decreased 2/3 sites unchanged	Marginal Increase
Song 2012[31]	**Improved§:** Aggregates for chronic care (3.7% difference in differences), preventative care (0.4% difference in difference), pediatric care (1.3% difference in differences) ***No outcome measures***	Increased	Not Reported	Not Reported	Average total quarterly spending per member decreased ($22.58 savings)	Decreased	Increased
Chen 2010[25]	**Improved:** Receipt of quality care (2 A1c and 1 LDL check) (OR 1.2) ***No outcome measures***	Increased	Hospitalization decreased (RR 0.75)	Decreased	Not Reported	Not Reported	Increased

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
Fagan 2010[35]¶¶	P4P incentivized measures: **Increased:** Influenza vaccination (OR 1.79) **Decreased:** HbA1C testing (OR 0.44) and LDL screens (OR 0.62) **Unchanged:** Diabetic eye exam, nephropathy screen, non-incentivized: ACE inhibitor use, short-acting antihypertensives ***No outcome measures***	1/7 increased 2/7 decreased 4/7 unchanged	ED visits unchanged	No Change	Total cost to insurer unchanged	No Change	Marginal Decrease
Gilfillan 2010[34]	**Improved:** 30 day readmissions (36% reduction) ***Outcome measure improved***	Increased	Admissions decreased (18% reduction)	Decreased	Plan payment plus member copayment unchanged	No Change	Increased
Leitman 2010[29]	Noted improved compliance with core measures (acute MI, heart failure, pneumonia and surgical care); not reported based on participation ***No outcome measures***	Unclear	Length of stay unchanged	No Change	Savings compared to baseline ($38000/ physician over 3-year period)	Decreased	Increased
Reid 2010[19]≠	**Improved:** Quality of care composite (6% to 7.3%), pati ent satisfaction (3/5 ACES and 2/2 PACI C) ***No outcome measures***	Increased	Decreased: Primary care visits (RD 0.94), ED visits (RD 0.71), Inpatient admissions - ambulatory care-sensitive conditions (RD 0.87), Inpatient admissions - all causes (RD 0.94) I ncreased: Specialty visits (RD 1.03)	4/5 decreased 1/5 increased	Total cost per patient per month unchanged	No Change	Increased
Ryan 2009[30]	**Unchanged:** 30 day mortality for AMI, HF,	No Change	Not Reported	Not Reported	60 day cost//: AMI decreased (27.1 to 25.1) HF increased	1/3 decreased 1/3 increased 1/3 no change	No Change

Author, year	Quality outcomes	Quality results summary	Utilization outcomes	Utilization results summary	Cost outcomes	Cost results summary	Value
	pneumonia, and CABG ***Outcome measures unchanged***				(13.1 to 13.4) Pneumonia unchanged		

[*] Changes labeled marginal net change seen in only one of many measures

[†] Measure was not tied to P4P

[‡] Multiple reports same intervention using different outcomes

[§] Adjusted

[//] Significant in only one model for non-dually eligible

[¶] Within patient satisfaction only 2/7 measures improved

[**] Statistical significance not reported for any outcomes

[††] Acute inpatient admissions decreased (18% decrease in intervention vs. 18% increase in control); specialty visits decreased (0% vs. 10% increase in control); ED visits increased (15% increase vs. 4% decrease in control)

[‡‡] For Wellpoint members, cost increased 5% in intervention compared to 12% in control practices

[§§] Years 1 and 2 reported separately; all results are for year 2

[///] Dollars per member per month decreased compared to control sites in year 2 (although higher in year 1)

[¶¶] ORs are for change in intervention compared to change in control