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Interventions to Promote Health and Increase Health Care Efficiency: *A Review of the Evidence*

The Washington State Legislature directed the Washington State Institute for Public Policy (WSIPP) to "calculate the return on investment to taxpayers from evidence-based prevention and intervention programs and policies."[1] Additionally, WSIPP's Board of Directors authorized WSIPP to work on a joint project with the MacArthur Foundation and Pew Charitable Trusts to extend WSIPP's benefit-cost analysis to certain health care topics.

The Pew-MacArthur Results First Initiative identified several health care topics as important for states. This report reviews evidence on six: "lifestyle" programs to prevent diabetes; behavioral interventions to reduce obesity; smoking cessation during pregnancy; transitional care to prevent hospital readmissions; patient-centered medical homes; and programs to reduce avoidable emergency department visits.

An important goal is to determine whether these programs help states control Medicaid and other health care costs. In this report, we review the effectiveness of these policies and programs. In subsequent reports, WSIPP will present benefit-cost results for these programs and other health care interventions. Section I of this report outlines our research approach, and Section II discusses our findings.

Summary

WSIPP's Board of Directors authorized WSIPP to work on a joint project with the MacArthur Foundation and the Pew Charitable Trusts to extend WSIPP's benefit-cost analysis to certain health care topics. An important goal is to determine whether there are strategies that can help states control Medicaid and other health care costs.

This report reviews evidence on six topics: "lifestyle" programs designed to prevent diabetes; behavioral interventions to reduce obesity; smoking cessation during pregnancy; transitional care to prevent hospital readmissions; patient-centered medical homes; and programs to reduce avoidable emergency department visits.

For each topic, we gathered all of the research we could locate from around the United States and elsewhere. We screened the studies for methodological rigor and then computed an average effect of the programs on specific outcomes.

We found evidence that some approaches can achieve desired outcomes but others do not. We explain these results in this report and display them in a summary table, Exhibit 1.

At this stage of the project, we have not computed benefits and costs for these findings. Rather, in this report we describe whether the programs achieve effects on outcomes, and, if so, the magnitudes of those effects. Subsequently, WSIPP will present benefit-cost results for these programs and other health care interventions.

[1] Engrossed Substitute House Bill 1244, Chapter 564, Laws of 2009.

I. Research Methods

When WSIPP is asked to identify "what works" and "what does not work" on a given topic, we begin by locating all of the studies we can find from around the United States and elsewhere.

We analyze all high-quality studies to identify program effects. We look for research studies with strong evaluation designs and exclude studies with weak research methods. For example, to be included in our review, a study must have had a treatment and comparison group and demonstrated comparability between groups.[2]

We calculate "effect sizes" for each study. An effect size measures the degree to which a program has been shown to change an outcome (such as diabetes incidence) for program participants relative to a comparison group.

Our empirical approach then follows a meta-analytic framework to assess systematically all credible evaluations we can locate on a given topic. Given the weight of the evidence, we calculate an average expected effect of a policy on a particular outcome of interest, as well as an estimate of the margin of error for that effect. The average effect size is a measure of the degree to which a program works. We describe this method in detail in WSIPP's Technical Documentation.[3]

[2] Other common reasons for excluding studies include treatment groups consisting solely of program completers, high study attrition rates without intent-to-treat analysis, and a failure to report the information required to estimate effect sizes for outcomes of interest.

[3] Washington State Institute for Public Policy (2014). *Benefit-cost technical documentation.* Olympia, WA: Author. Retrieved from http://www.wsipp.wa.gov/TechnicalDocumentation/WsippBenefitCostTechnicalDocumentation.pdf

II. Research Findings

This section presents findings for six topics:

1) Lifestyle programs designed to prevent type 2 diabetes
2) Behavioral interventions to reduce obesity
3) Smoking cessation during pregnancy
4) Care transition to prevent hospital readmissions
5) Patient-centered medical homes
6) Programs to reduce avoidable emergency department (ED) visits

Average effect sizes are in Exhibit 1. The studies used in our analysis are listed in Appendix A.

1) Lifestyle interventions to prevent diabetes

People with type 2 diabetes, the most common form of the disease, either do not produce enough insulin or their bodies cannot use it properly. Lifestyle programs target individuals at high risk for developing type 2 diabetes, providing them with counseling and other support. The programs included in this review aim to improve diet, increase physical activity, and reduce weight and the incidence of diabetes.

A number of clinical trials have evaluated the effectiveness of long-term, intensive programs with individual counseling. Typical programs in this category include three years of active intervention with individual counselling sessions and supervised exercise classes.

There are also shorter-term, group-based counseling programs that provide diabetes prevention at lower cost in community settings (e.g., YMCAs, churches). Other programs are less intensive and provide individual counseling.

When possible, we report average effect sizes separately for (a) all programs, (b) intensive programs with individual counseling, and (c) shorter-term, group-based counseling programs.[4]

In the studies we reviewed, diabetes incidence was the primary outcome of interest. Secondary outcomes included weight change and fasting glucose levels.

We find that lifestyle interventions, on average, have a significant effect on diabetes incidence, weight loss, and blood glucose levels. Programs typically reduce the risk of diabetes onset by about half by the end of active intervention.

Long-term follow-up data are available from clinical trials of the intensive programs. These data indicate that effects on diabetes persist over time, though effect sizes decline as more of these high-risk individuals eventually experience disease onset.

[4] Unfortunately, many of the studies of the shorter-term, group-based programs have limited follow-up periods and few report effects on diabetes incidence; most do report weight loss outcomes.

Weight loss appears to be critical in preventing diabetes.[5] Our review indicates that shorter-term, group-based programs promote weight loss, although effects vary across studies.[6] Participants typically lose an average of 4% to 6% of body weight in these group-based programs at 12 months follow-up.

2) Behavioral interventions to reduce obesity

2a) Obesity interventions for adults. Behavioral interventions for obesity include behavioral counseling/therapy/educational components conducted remotely, in primary care, or other clinical environments. The programs often include diet and exercise components. For this review of interventions for adults who are obese, we excluded studies that target diabetic populations, as well as those aimed at preventing obesity.

We categorized adult obesity interventions based on the delivery method and the intensity of the intervention. The methods were classified as remote or face-to-face delivery. Within face-to-face delivery, we further categorized interventions as high- or low-intensity. Our cut-off for high-intensity interventions is 12 or more sessions a year with duration of 12 months or more. (Note that this classification is different for childhood obesity interventions, discussed later.)

The primary outcomes reported in the studies we reviewed for this topic include body mass index (BMI) and weight change. Secondary outcomes reported include change in blood pressure and cholesterol.

Exhibit 1 presents average effect sizes. High-intensity, face-to-face interventions had the largest impacts on primary outcomes. For example, we found that a typical 50-59 year-old participant in one of these interventions would be expected to weigh about 12 pounds less than a similar individual who did not receive the treatment.[7]

We also found that remotely delivered interventions produced smaller effects on weight and BMI than high-intensity programs. Low-intensity interventions did not have statistically significant effects on any of the primary outcomes.

2b) Obesity interventions for children. The behavioral interventions included in this analysis target obese and overweight youth under age 18, providing them with counseling, education, and other supports to improve diet, increase physical activity, and reduce weight. The programs use techniques designed to promote and sustain behavioral change, including goal setting, self-monitoring, stimulus control, and other strategies. This analysis excludes prevention programs and interventions with pharmacological or surgical components.

[5] Hamman, R.F., Wing, R.R., Edelstein, S.L., Lachin, J.M., Bray, G.A., Delahanty, L., Hoskin, M., ... Wylie-Rosett, J. (2006). Effect of weight loss with lifestyle intervention on risk of diabetes. *Diabetes Care, 29*(9), 2102-7 and Knowler W., Fowler S., Hamman R., Christophi C. Hoffman H., Brenneman A., Brown-Friday J., Goldberg R., Venditti E., & Nathan D. (2009). 10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study. *The Lancet, 374*(9702), 1677-1686.

[6] For a more extensive discussion of these programs, see the forthcoming WSIPP report: *Diabetes Prevention Programs: A Review of the Evidence.*

[7] Based on 2007-2010 reference data for adults in the United States from: Fryar, C.D., Gu, Q., & Ogden, C.L. (2012). *Anthropometric reference data for children and adults: United States 2007-2010* (Vital and Health Statistics, Series 11, Number 252). Retrieved from http://www.cdc.gov/nchs/data/series/sr_11/sr11_252.pdf.

The formats and structures of the programs varied. Most programs were delivered through direct, face-to-face counseling and activity sessions, though some programs were delivered over the phone or online. Face-to-face programs included both individual- and group-based programs. Children were the primary participants in some programs, while other programs included parent and family components.

We categorized the studies based on recommendations from the US Preventive Services Task Force.[8] We used the total number of face-to-face contact hours between participants and intervention staff as an indicator of program intensity. We divided the studies into low-intensity interventions (less than 25 hours of contact), moderate-to-high intensity interventions (25 or more hours of contact), and interventions delivered remotely (phone- and internet-based).

The primary outcomes reported in the studies we reviewed for this topic include BMI and weight change.

We found that moderate-to-high intensity interventions had significant effects on BMI and weight in children. For example, based on our results we would expect a typical 11-year-old child who received treatment to weigh about eight pounds less, on average, than a similar child who did not receive treatment.[9]

Low-intensity interventions had significant effects on BMI, although the effect size is less than half of higher-intensity interventions. Participants in remotely delivered interventions showed reductions in BMI and weight, on average, but the effects were not significant.

3) Smoking cessation for pregnant women

Smoking during pregnancy has been shown to increase the risks of low birth weight and preterm delivery and add to health care costs.[10] We examined evidence for the effectiveness of smoking cessation counseling programs in reducing smoking rates during late pregnancy. These programs recruit women who smoke early in their pregnancy and provide them with face-to-face counseling, phone counseling, and self-help materials to help them quit.[11] Interventions vary in the number of contacts and duration of sessions.

We identified 18 studies that (a) met our methodological requirements; (b) included counseling services in the intervention; (c) were conducted in the US; (d) recruited women who smoked early in their pregnancy; and (e) used laboratory tests to confirm smoking status.[12] Eleven of the studies recruited women with low incomes; thus, the

[8] US Preventive Services Task Force. (2014). Final Recommendation Statement: Obesity in Children and Adolescents: Screening. Retrieved from http://www.uspreventiveservicestaskforce.org/Page/Document /RecommendationStatementFinal/obesity-in-children-and-adolescents-screening.

[9] Based on 2007-2010 reference data for children in the United States from Fryar et al., (2012).

[10] Adams E., Markowitz S., Dietz P., & Tong V. (2013). Expansion of Medicaid Covered Smoking Cessation Services: Maternal Smoking and Birth Outcomes. *Medicare & Medicaid Research Review 3*(3), E1-E23 and Coleman T., Chamberlain C., Davey M.A., Cooper S.E., Leonardi-Bee J. (2012). Pharmacological interventions for promoting smoking cessation during pregnancy (Review). *Cochrane Database of Systematic Reviews*. Issue 9.

[11] We did not review evidence for the effectiveness of nicotine replacement (NRT) and other pharmacotherapy.

[12] In identifying potential studies, we relied heavily on Chamberlain, C., O'Mara-Eves, A., Oliver, S., Caird, J.R., Perlen, S.M., Eades, S.J., & Thomas, J. (2013). Psychosocial interventions for supporting women to stop smoking in pregnancy. *Cochrane Database of Systematic Reviews*, 10.

results are relevant to Medicaid enrollees.[13] (See Appendix A for a list of the studies included in our analysis.)

We calculated average effect sizes on smoking during late pregnancy. Across the 18 studies, smoking cessation programs significantly reduced smoking among pregnant women (Exhibit 1). On average, 19% of women in the treatment groups quit smoking versus 12% among control groups. Nine of the studies included more substantial, face-to-face counseling.[14] The effect size for these interventions was slightly higher than for programs with only brief or no face-to-face counseling.

4) Transitional care programs to prevent hospital readmissions

According to the Agency for Healthcare Research and Quality, hospital readmissions are common and costly.[15] Our analysis examines evidence for the effectiveness of "transitional care" programs in reducing hospital readmissions. Transitional care may include coaches, patient education, medication reconciliation, individualized discharge planning, enhanced provider communication, and patient follow-up after discharge.[16]

We reviewed evaluations of the effects of transitional care on hospital readmissions. The analysis reported here focuses on studies conducted in the US.[17]

Transitional care programs vary in the services provided and patient populations recruited. In terms of services, we categorized programs as "comprehensive" or "post-discharge" follow-up. Comprehensive interventions include pre-discharge assistance (e.g., a transition coach, enhanced discharge planning, and primary care provider communication) and post-discharge follow-up. Post-discharge interventions include only patient follow-up.

Transitional care programs in the US typically recruit high-risk populations of elderly and/or chronically ill patients (with chronic heart disease, coronary artery disease, diabetes, and stroke). A few programs studied recruit from general populations of admitted patients, without regard to age or condition.

[13] The US Centers for Disease Control and Prevention (CDC) estimates that among women who gave birth during 2011, one in ten smoked during the last three months of pregnancy. The rate was higher among Medicaid enrollees, with one in five women smoking during late pregnancy.

[14] These studies included more than one personal contact or one lengthy face-to-face session with additional phone counseling.

[15] Hines, A.L., Barrett, M.L., Jiang, H.J., & Steiner, C.A. (2014). Conditions with the Largest Number of Adult Hospital Readmissions by Payer, 2011. HCUP Statistical Brief #172. Agency for Healthcare Research and Quality, Rockville, MD. http://www.hcup-us.ahrq.gov/reports/statbriefs/sb172-Conditions-Readmissions-Payer.pdf

[16] Hansen, L.O., Young, R.S., Hinami, K., Leung, A., & Williams, M.V. (2011). Interventions to reduce 30-day hospitalization: A systematic review. *Annals of Internal Medicine, 155*(8), 520-528.

[17] Programs in the US have a larger mean effect size than do those based in other countries. This is partially due to the mix of intervention types and target populations. Studies outside the US are more likely to include only post-discharge follow-up and to recruit non-chronically ill, elderly patients. Differences in health care systems may also contribute to differences in program effects across countries; Jaarsma, T., Halfens, R., Abu-Saad, H.H., Dracup, K., Gorgels, T., Van Ree, J., & Stappers, J. (1999). Effects of education and support on self-care and resource utilization in patients with heart failure. *European Heart Journal, 20*(9), 673-682; Shepperd, S., Lannin, N.A., Clemson, L.M., McCluskey, A., Cameron, I.D., & Barras, S.L. (2013). Discharge planning from hospital to home. *Cochrane Database System Review, 1*.

Average effect sizes are reported in Exhibit 1. We find that, on average, transitional care is effective in reducing hospital readmissions, especially the comprehensive programs and those that target high-risk patients.[18] For example, among the studies included in our analysis, the typical comprehensive program reduces readmission rates from a base of 22% down to 15%.

5) Patient-centered medical homes

The "patient-centered medical home" (PCMH) model attempts to make health care more efficient by restructuring primary care. About half the states, including Washington, have implemented PCMH pilots for Medicaid enrollees.[19] Definitions vary, but PCMHs typically provide health care with the following features:

- Team-based (with team members having defined roles and shared accountability);
- Comprehensive (with the majority of health care needs being addressed);
- Coordinated (across primary care providers, specialists, hospitals, and community service providers);
- Patient-centered (with shared decision-making and support for patient self-management);
- Emphasis on quality and safety (with clinical decision-support tools and methods to track care); and
- Enhanced access (with expanded office hours and shorter waiting times).

PCMHs span two dimensions—provider structure and patient population. Both physician-led primary care practices and integrated health delivery systems have established medical homes. Some implementations include general patient populations and others recruit high-risk elderly or chronically ill patients.[20]

The evidence base for PCMHs is growing. We located and conducted full reviews of 67 studies. Unfortunately, only 11 of these met our methodological requirements and reported outcomes of interest, and, thus, were included in the meta-analysis.[21]

We reviewed evidence on the effectiveness of patient-centered medical homes in reducing emergency department (ED) utilization, hospitalizations, and total medical costs. We report average effect sizes (Exhibit 1) for all PCMH implementations, integrated health system implementations, physician-led practice implementations, and those that recruit high-risk patients.

There is emerging evidence that PCMH implementations reduce ED visits. Across all the studies in our analysis, medical homes

[18] Please see the forthcoming WSIPP report, *Reducing Hospital Readmissions*, for a more extensive discussion of these programs.

[19] Takach, M. (2012). About half of the states are implementing patient-centered medical homes for their Medicaid populations. *Health Affairs, 31*(1), 2432-2440 and Takach, M. (2011). Reinventing Medicaid: State innovations to qualify and pay for patient-centered medical homes show promising results. *Health Affairs, 30*(7), 1325-1334.

[20] The Medicaid Health Home, a more recent variant of the medical home model, focuses on patients with serious mental illness and substance abuse disorders. WSIPP has reviewed the evidence on health homes; those findings are reported on our website: http://www.wsipp.wa.gov/BenefitCost

[21] PCMH evaluations face serious methodological challenges. Few studies are randomized controlled trials, and results are often subject to potential biases because physicians volunteer their clinics to become medical homes. In addition, many studies include too few practices to estimate effects on service utilization and cost outcomes. (The studies used in our analysis are reported in Appendix A.)

reduce ED visits by about 3%.[22] We did not find evidence that PCMHs significantly reduce hospitalizations or total cost of care.

6) Interventions to reduce emergency department use

Medicaid clients use the ED more frequently than those with no insurance or private insurance.[23] Some states, including Washington, have identified reducing ED use among Medicaid clients as a way to reduce expenditures.[24]

For this report, we examined three interventions to prevent the need for ED visits and reduce non-urgent ED use: (a) case management for frequent ED users, (b) general education on appropriate ED use, and (c) asthma self-management education for children. Subsequent reports may examine other interventions aimed at reducing emergency department use. The effect sizes for these interventions are reported in Exhibit 1.

6a) Case management for frequent ED users.

Frequent users account for less than 10% of ED users but more than 20% of visits.[25] Case management is one strategy that health care systems are using in attempt to reduce the number of ED visits due to frequent users.

We reviewed the research literature on case management programs for frequent ED users and found only two studies that met WSIPP's criteria for scientific rigor. Based on these two studies, we found that case management may be effective in decreasing ED use. For example, in the studies that we reviewed, frequent ED users receiving case management visited the ED two times in a six month period compared with four times in a six month period for those receiving usual care. We also find that case management tends to reduce hospitalizations.

[22] Please see the forthcoming WSIPP report, *Patient-Centered Medical Homes: A Review of the Evidence,* for a more extensive discussion of these programs.

[23] National Center for Health Statistics. (2014). *Health, United States, 2013*: *With Special Feature on Prescription Drugs.* Retrieved from http://www.cdc.gov/nchs/hus.htm

[24] Third Engrossed Substitute House Bill 2127, Sec. 213(43), Chapter 7, Laws of 2012, E2.

[25] LaCalle, E., & Rabin, E. (2010). Frequent users of emergency departments: the myths, the data, and the policy implications. *Annals of Emergency Medicine, 56*(1), 42-48.

6b) General education on appropriate ED use. Educating patients on the most appropriate setting to seek care is another strategy that has been used to attempt to reduce non-urgent ED use.

We conducted an extensive search for research studies from around the United States and elsewhere on the effectiveness of general education on appropriate ED. Unfortunately, we found only one study that met WSIPP's criteria for scientific rigor and reported sufficient data to calculate an effect.

We did not find strong evidence from this single study that general education on appropriate use reduces ED visits.

6c) Asthma self-management education among children. Asthma is one of the most common chronic diseases among children in the United States.[26] Most patients with asthma can control the disease with proper management. However, poorly controlled asthma symptoms contribute to hospitalization and ED visits.[27]

Many states, including Washington, have developed statewide comprehensive asthma plans that include improving access to asthma self-management education.[28]

We reviewed the research literature on asthma self-management education for children initiated in a health care setting. We found 12 studies that met WSIPP's criteria for scientific rigor. These studies measured the impact of asthma self-management education for children on ED use, hospitalization, and school absences. We did not find a significant decrease in any of these three outcomes in children who received self-management education.

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[26] Bloom, B., Jones, L. I., & Freeman, G. (2013). *Summary health statistics for U.S. children: National Health Interview Survey, 2012*. Retrieved from http://www.cdc.gov/nchs/fastats/asthma.htm
Approximately 6.7% of children in the Washington State currently have asthma. Washington State Department of Health. (2013). *The burden of asthma in Washington State, 2013 update*. (DOH Report 345-240). Retrieved from http://www.doh.wa.gov/Portals/1/Documents/Pubs/345-240-AsthmaBurdenRept13.pdf.

[27] Akinbami, L.J., Moorman, J.E., Bailey, C., Zahran, H.S., King, M., Johnson, C.A., & Lui, X. (2012). *Trends in asthma prevalence, health care use, and mortality in the United States, 2001–2010* (NCHS data brief, no 94). Retrieved from http://www.cdc.gov/nchs/data/databriefs/db94.htm

[28] Washington State Department of Health. (2011). *Washington State asthma plan, 2011-2015,* (DOH 345-290). Retrieved from http://www.doh.wa.gov/Portals/1/Documents/Pubs/345-290_AsthmaPlan2011-15.pdf

Exhibit 1

Summary of Meta-Analytic Findings of Selected Health Care Interventions

Intervention	Outcome	Measurent period	# of effect sizes	Average effect size	Standard error	P-value	# in treatment groups
Lifestyle programs to prevent type 2 diabetes							
1) All programs	Diabetes incidence	end of active intervention	11	-0.387	0.050	0.000	2,812
	Weight change	12-15 months	12	-0.221	0.034	0.000	2,457
2) Long-term, intensive, individual counseling	Diabetes incidence	end of active intervention	2	-0.533	0.098	0.000	1,344
	Weight change	12 months	2	-0.298	0.052	0.000	1,344
	Fasting glucose	12 months	2	-0.453	0.053	0.000	1,344
3) Shorter-term, group-based counseling	Weight change	12-15 months	6	-0.235	0.068	0.001	547
	Fasting glucose	6-15 months	7	-0.292	0.074	0.000	763
Behavioral interventions to reduce obesity for adults							
1) High-intensity in-person delivery	Weight change	end of intervention	12	-0.174	0.050	0.001	2,070
	BMI change		9	-0.238	0.087	0.006	1,357
	Diastolic blood pressure		8	-0.340	0.165	0.040	1,641
	Systolic blood pressure		8	-0.123	0.047	0.009	1,641
	HDL cholesterol		7	0.049	0.051	0.343	986
	LDL cholesterol		7	-0.011	0.051	0.827	986
2) Low-intensity in-person delivery	Weight change	end of intervention	10	-0.084	0.057	0.138	1,004
	BMI change		4	-0.040	0.079	0.610	554
	Diastolic blood pressure		6	-0.146	0.073	0.047	697
	Systolic blood pressure		6	-0.112	0.078	0.154	697
	HDL cholesterol		4	0.069	0.181	0.705	474
	LDL cholesterol		4	-0.205	0.100	0.041	474
3) Indirect counseling (via computer or phone)	Weight change	end of intervention	9	-0.115	0.046	0.013	1,092
	BMI change		5	-0.139	0.057	0.015	608
	Diastolic blood pressure		5	-0.069	0.056	0.219	627
	Systolic blood pressure		5	-0.101	0.056	0.073	627
Behavioral interventions to reduce obesity for children							
1) Moderate- to High-intensity	BMI change	3-12 months	14	-0.378	0.087	0.000	638
	Weight change	3-12 months	11	-0.206	0.070	0.003	493
2) Low-intensity	BMI change	3-24 months	12	-0.148	0.054	0.006	778
	Weight change	3-12 months	4	-0.201	0.143	0.160	94
3) Interventions delivered remotely	BMI change	3-7 months	4	-0.151	0.131	0.249	142
	Weight change	3-4 months	3	-0.117	0.178	0.510	74
Smoking cessation programs during pregnancy							
1) All cessation counseling programs	Smoking	late pregnancy	18	-0.276	0.075	0.000	3,186
2) Intensive, face-to-face counseling	Smoking		9	-0.301	0.114	0.008	1,427
3) Brief or no face-to-face counseling	Smoking		9	-0.235	0.094	0.013	1,759
Transitional care programs to prevent hospital readmissions							
1) All programs - high risk patients	Readmissions	30-days	12	-0.278	0.060	0.000	1,375
2) All programs - general patient populations	Readmissions		4	-0.155	0.107	0.147	972
3) Comprehensive programs	Readmissions		11	-0.289	0.061	0.000	1,597
4) Post-discharge follow-up only	Readmissions		5	-0.143	0.089	0.107	750
Patient-Centered Medical Homes							
1) All PCMH implementations	Emergency department visits	1-3 years	8	-0.019	0.010	0.049	459,478
	Hospital admissions	2-3 years	8	0.001	0.003	0.847	385,985
	Total cost of care	2-3 years	6	0.004	0.006	0.431	75,632
2) Integrated health system implementations	Emergency department visits	3 years	1	-0.032	0.004	0.000	305,578
	Hospital admissions	3 years	2	0.001	0.004	0.766	314,212
	Total cost of care	2-3 years	2	-0.021	0.071	0.771	15,562
3) Physician-led practice implementations	Emergency department visits	1-3 years	7	-0.015	0.010	0.148	153,900
	Hospital admissions	2-3 years	6	0.000	0.005	0.934	71,773
	Total cost of care	2-3 years	4	0.005	0.006	0.416	59,980
4) High-risk patient implementations	Emergency department visits	1-3 years	3	-0.034	0.030	0.252	31,147
	Total cost of care	2-3 years	3	-0.040	0.029	0.178	12,472
Interventions to reduce emergency department visits							
1) Case management for frequent users	Emergency department visits	0.5-2 years	2	-0.438	0.095	0.000	252
	Hospitalization	0.5-2 years	2	-0.173	0.094	0.067	252
2) General education on appropriate use	Emergency department visits	6.5 months	1	-0.032	0.021	0.128	9,822
3) Asthma self-management education: children	Emergency department visits	12-14 months	7	-0.088	0.124	0.475	688
	Hospitalization	6-18 months	10	0.015	0.099	0.883	1,342
	School absences	6-13 months	4	-0.002	0.219	0.994	142

Appendix A

Studies used in the Meta-Analyses

Lifestyle interventions to prevent diabetes – All programs

Ackermann, R.T., Finch, E.A., Brizendine, E., Zhou, H., & Marrero, D.G. (2008). Translating the Diabetes Prevention Program into the community. The DEPLOY Pilot Study. *American Journal of Preventive Medicine, 35*(4), 357-63.

Bhopal, R.S., Douglas, A., Wallia, S., Forbes, J.F., Lean, M.E., Gill, J.M., McKnight, J.A., ... Murray, G.D. (2014). Effect of a lifestyle intervention on weight change in south Asian individuals in the UK at high risk of type 2 diabetes: a family-cluster randomised controlled trial. *The Lancet. Diabetes & Endocrinology, 2(*3), 218-27.

Haffner, S., Temprosa, M., Crandall, J., Fowler, S., Goldberg, R., Horton, E., Marcovina, S., ... Diabetes Prevention Program Research Group. (2005). Intensive lifestyle intervention or metformin on inflammation and coagulation in participants with impaired glucose tolerance. *Diabetes, 54*(5), 1566-72.

Katula, J.A., Vitolins, M.Z., Rosenberger, E.L., Blackwell, C.S., Morgan, T.M., Lawlor, M.S., & Goff, D.C.J. (2011). One-year results of a community-based translation of the Diabetes Prevention Program: Healthy-Living Partnerships to Prevent Diabetes (HELP PD) Project. *Diabetes Care, 34*(7), 1451-7.

Katula, J.A., Vitolins, M.Z., Morgan, T.M., Lawlor, M.S., Blackwell, C.S., Isom, S.P., Pedley, C.F., ... Goff, D.C.J. (2013). The Healthy Living Partnerships to Prevent Diabetes study: 2-year outcomes of a randomized controlled trial. *American Journal of Preventive Medicine, 44*(4), 324-32.

Knowler, W.C., Barrett-Connor, E., Fowler, S.E., Hamman, R.F., Lachin, J.M., Walker, E.A., Nathan, D.M., ... Diabetes Prevention Program Research Group. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *The New England Journal of Medicine,* 346(6), 393-403.

Kosaka, K., Noda, M., & Kuzuya, T. (2005). Prevention of type 2 diabetes by lifestyle intervention: a Japanese trial in IGT males. *Diabetes Research and Clinical Practice,* 67(2), 152-162.

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Patient-centered medical homes – High-risk patient implementations

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