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The Impact of the Patient-Centered Medical Home on Health Disparities in Adults: A Systematic Review of the Evidence

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ABSTRACT

Introduction: The objective of this study was to review the empirical evidence on Patient-Centered Medical Home (PCMH) impact on health disparities in adults.

Methods: We searched PubMed, Scopus, and Google Scholar to identify studies on PCMH/health homes and health disparities published in English between January 1, 2009 and December 31, 2014. Articles met inclusion criteria if they investigated at least one component of PCMH or health homes in vulnerable populations, defined by PROGRESS-PLUS criteria, and reported differences in one of five clinical quality measures.

Results: 964 articles were identified through database searching and subsequent snowballing. 60 articles underwent full text screening. Further review eliminated 56 studies. In the final 4 studies, PCMH interventions showed small improvements in health disparities.

Discussion: The PCMH has been suggested as a model for improving health disparities. Given rapid implementation in underserved settings, stakeholders should better understand the impact of the PCMH on health disparities.

Keywords: African Americans; knowledge; beliefs; cancer information; health belief model; HINTS data

INTRODUCTION

The Patient-Centered Medical Home (PCMH) is a model of primary care that is patient-centered, comprehensive, team-based, coordinated, accessible, and focused on quality and safety (AHRQ, n.d.). The PCMH model is rapidly gaining momentum in the United States, expanding from 1,506 recognized sites in 2010 to 4,937 sites in 2012; as of 2014 caring for 35-40 million patients (Edwards ST, Bitton A, Hong JS, 2014). Practices in the United States may be recognized or accredited as PCMHs through national bodies, such as the National Committee on

Quality Assurance/NCQA, the Joint Commission, and the Accreditation Association for Ambulatory Health Care/AAAHC, as well as state-based and payer programs. In some settings, particularly in Medicaid-serving environments, the term “Health Home” is used. Health homes, as defined in Section 2703 of the Affordable Care Act, Centers for Medicare and Medicaid Services (CMS), and the Substance Abuse and Mental Health Services Administration (SAMSHA), expand the concept of PCMH to include coordination of care for people with chronic conditions, as well as mental health and substance abuse disorders (Alexander, 2012). In this study, we consider PCMH as a larger construct, encompassing health homes as well.

Studies on the PCMH have demonstrated considerable evidence supporting the model, including reductions in health care costs and unnecessary utilization of hospital and emergency services, improvements in clinical measures and preventive services, increased access to primary care, and in some cases, increased satisfaction among patients, staff and clinicians (Grumbach, 2013; Helfrich, Christian D., 2014; Nelson et al., 2014; Nielsen, M. Olayiwola, J.N., Grundy, P., Grumbach, K. (ed.) Shaljian, 2014; Nielsen, M., Gibson, L., Buelt, L., Grundy, P., & Grumbach, 2015). However, little is known about the impact of the PCMH on health disparities, particularly for adult populations. Health and health care disparities remain persistent public health challenges within the United States, for both clinical issues such as chronic diseases and cancer, as well as systems issues such as screening, access, utilization and treatment (Fiscella et al., 2011). While it is expected that PCMHs will cause global improvements in the quality of care and reduce disparities, due to the alignment of health care and services with patient needs and preferences, a pediatric primary care study showed that despite improved quality of care for children in medical homes versus children not in medical homes, disparities between white and black children were not significantly narrowed by the PCMH (Aysola, Bitton, Zaslavsky, & Ayanian, 2013; Fiscella et al., 2011). Another study found that Latino patients were much less likely to receive PCMH care, with mixed support for the moderating role of PCMH care for health services disparities in older adults (Tarraf, n.d.). In a comparison of patient experience of care between adults of different racial/ethnic groups under PCMH domains, Hispanic patients had less positive experiences than non-Hispanic whites. However, across racial/ethnic groups, patients in PCMH clinics with higher levels of transformation reported higher positive experiences (Kim, n.d.).

Considering the momentum around PCMH transformation, it is essential to gain more information on the impact of PCMH on health disparities.

In this study, we conducted a systematic review to identify the impact of the PCMH or health home models on health disparities in clinical quality for adults. We used the PROGRESS-Plus framework and followed the PRISMA-E 2012 reporting guidelines for systematic reviews with a focus on health equity (Jackson, Timothy D., Rujun Zhang, Dresden Glockler, Jason Pennington, Jacinta I. Reddigan, Ori D. Rotstein, Janet Smylie, Laure Perrier, 2014; Oliver S, Kavanagh J, Caird J, Lorenc T, Oliver K, Harden A, Thomas J, Greaves A, 2008; V. A. Welch et al., 2013; V. Welch et al., 2012).

METHODS

A full description of methods is available in the Online Appendix. The systematic review was registered in the PROSPERO database of the University of York Centre for Reviews and Dissemination (CRD42015019188).

Data Collection

From October 2014 to December 2014, plus an expansion of search terms in September 2015, we searched PubMed, Scopus, and Google Scholar databases for studies published in English between January 1, 2009 and December 31, 2014. We used this timeframe since the first iteration of the formal NCQA PCC-PCMH standards was in 2008 (NCQA, n.d.). We used the following key search terms: *PCMH, patient centered medical home, health home health status disparities, health care disparities, social determinants of health, health equity, minority health*. Online Appendix Exhibit 1A provides details of the exact search terms and results.

In the first stage of study selection, titles and abstracts were screened for relevance per the study inclusion and exclusion criteria. Inclusion criteria included: dates of publication - 1/1/2009-12/31/2014; written in English; mention of Patient centered medical home or health home in the abstract/title; AND mention of (a) social determinant of health including PROGRESS-Plus measures (Cochrane, n.d.; V. A. Welch et al., 2013) OR (b) patient groups/communities affected by these social determinants of health. If the abstract was unavailable, we completed a full text analysis when available. We applied the following exclusion criteria: PCMH/health home in the context of the pediatric population, including adolescents; PCMH/health home studies outside of the United States; PCMH/health homes in the context of specialty care or outside of primary care; and opinion, editorial, perspective pieces, pictorial, and case studies.

For completeness, we manually searched citations from 12 pertinent studies that did not meet full inclusion criteria (See snowball strategy in Online Appendix: Methods). One reviewer with content knowledge independently reviewed each title and abstract for inclusion. To ensure accuracy, a second senior reviewer independently screened 10% of randomly selected articles. Inter-rater validity testing using Cohen's Kappa (Lowry, n.d.) showed strong agreement ($\kappa > 0.8$) (Online Appendix Exhibit 2A).

Articles included in the initial screening underwent full-text screening. Two reviewers independently reviewed the full text of each article and indicated a decision to include or exclude the article for data abstraction. Investigators reviewed and discussed all discrepancies in inclusion/exclusion until concordance was reached.

The full-text screening criteria are described in detail in the Online Appendix: Methods section. Relevant studies focused on the PCMH or health home, defined using accepted standards or functional criteria, and its impact on health disparities/health inequities. Additionally, study population demographics met the PROGRESS-Plus framework of health disparities, which comprises the various socio-demographic factors across which disadvantage or vulnerability could exist for patients (Online Appendix Exhibit 3A).

Outcomes of interest included one of the clinical quality measures as defined by the National Quality Measures Clearinghouse-Agency for Healthcare Research & Quality (NQMC-AHRQ) (NQMC, 2015) including process of care, access to care, outcome of care, structure of care, and patient experience of care (Online Appendix Exhibit 4A).

Relevant study designs included randomized controlled trials, case-control, or observational studies. We also included qualitative studies if the previously described inclusion criteria were met.

Data Abstraction and Quality Assessment:

The Principal Investigator created a data abstraction form, which was reviewed and modified by the research team, and then pilot-tested by study team members to ensure accuracy as well as completeness. After finalization, the data abstraction form was utilized to

systematically extract information on the reviewed studies applying accepted protocols. Adapted from a systematic review data collection tool published by Zaza et al, the abstraction form included sections detailing study type, eligibility, study characteristics, PROGRESS-Plus criteria, outcomes, results, limitations and scientific quality (See Appendix: Methods) (Zaza et al., 2000). One consistent researcher with content knowledge in the area abstracted the data for each article, while a second senior researcher concurrently and independently abstracted the data and then reviewed the abstracted data of the first researcher, ensuring accuracy. Disagreements that were not resolved by discussion were referred to a third reviewer to finalize a decision.

We applied standard quality criteria to evaluate the quality of individual studies (Kmet, L.M., Lee, R.C. & Cook, 2004; Zaza et al., 2000). We summarized the study's quality as excellent, good, fair, or poor based on the score (see details in Online Appendix 5A).

Data Synthesis and Analysis:

PCMH and Health Home Definitions: Study settings were categorized as being PCMH if formally recognized by a PCMH-accrediting board, and as "functional medical homes" if they had some formal PCMH components or implemented a discrete PCMH intervention, but were not formally accredited as a PCMH. Similarly, health homes were defined as those that met formal or functional SAMSHA criteria.

Study Population: The study populations were thematically stratified into domains relating to the disparity assessed under the PROGRESS- PLUS domains.

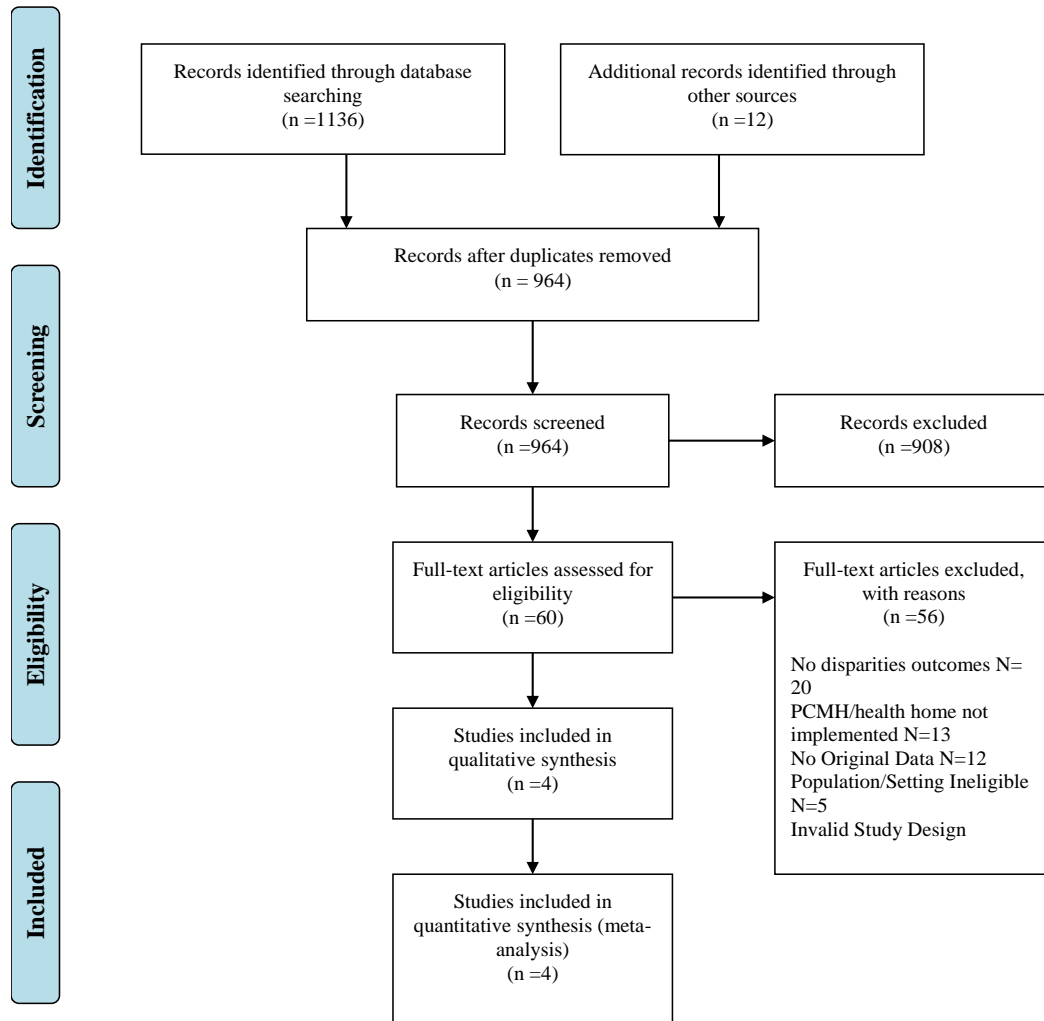
Study Outcomes: The heterogeneity of study designs and lack of power in this review precluded the use of meta-analytic techniques. Therefore, a thematic approach following principles articulated by Pope et al was used to analyze the studies included. Results were thematically grouped into domains relating to NQMC clinical quality measures (NQMC, 2015; Pope, Mays, & Popay, 2007).

RESULTS

Study Selection

We identified 964 citations from PubMed, Scopus, and Google Scholar. After abstract screening, 908 were excluded and 56 studies were included for full-text screening. Four additional studies were retrieved for full-text screening from snowballing, bringing the total for full-text screening to 60. Four studies were included in the final data abstraction (Figure 1) (Beal, Hernandez, & Doty, 2009; Berenson, Doty, Abrams, & Shih, 2012; Lee, Palacio, Alexandraki, Stewart, & Mooradian, 2011; Roby & Pourat, 2010).

Figure 1. Summary of Search and Selection



SOURCE: Authors' search and selection strategy

DIAGRAM SOURCE: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

NOTES: Search performed from October 1, 2014-December 31, 2014, and expanded in September 2015 to include Health Homes.

Final Study Sample

Comparative study characteristics for the four studies in the final sample described below are summarized in Table 1. All four studies included PCMH characteristics; none formally included health homes. None of the four studies had formal PCMH recognition from accrediting organizations. One study had a discrete PCMH intervention following NCQA/Joint Principles PCMH guidelines (Lee et al., 2011). Three were classified as functional PCMH (Beal et al., 2009; Berenson et al., 2012; Roby & Pourat, 2010) because they were not formally recognized but included critical components of the PCMH.

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Of the four studies, three were cross-sectional studies (Beal et al., 2009; Berenson et al., 2012; Roby & Pourat, 2010) and one was a prospective cohort study (Lee et al., 2011). All four studies provided quantitative data: two from national surveys (Beal et al., 2009; Berenson et al., 2012) and two from local community-based interventions (Lee et al., 2011; Roby & Pourat, 2010). Detailed descriptions of the included studies are provided in Online Appendix Exhibit 5A.

Three studies examined race/ethnicity disparities (Beal et al., 2009; Lee et al., 2011; Roby & Pourat, 2010), 2 examined income disparities (Berenson et al., 2012; Roby & Pourat, 2010), 2 examined gender disparities (Lee et al., 2011; Roby & Pourat, 2010), and 1 study examined age disparities (Roby & Pourat, 2010). All studies were rated as being of good quality (Table 1).

Table 1. Comparative Study Characteristics and Reported Outcomes			
Study Characteristic	Total Studies (n=4),n	Functional PCMH Studies (n=3), n	Discrete PCMH intervention (n=1),n
Observational Study Design	4	3	1
Cohort	1	0	1
Cross-sectional	3	3	0
Region			
National	2	2	0
Local	2	1	1
PCMH Comparison			
No source of regular care	1	1	0
Usual source of regular care	3	2	1
No comparator group	1	1	0
Population			
Adults 19-64	1	1	0
General adults >18	1	1	0
General adults >22	1	1	0
Adults with chronic disease	1	0	1
Disparity examined			
Race/Ethnicity	3	2	1
Income	2	2	0
Gender	2	1	1
Age	1	1	0
Overall study quality			
Excellent	0	0	0
Good	4	3	1
Fair	0	0	0
Poor	0	0	0
Process of care outcomes reported	3	2	1
Preventive Services	2	2	0
Chronic Illness care services	1	0	1
Access outcomes reported	2	1	1
Clinic follow up time	1	0	1
Cost-related access problems	1	1	0
Outcomes reported	2	1	1
Clinical outcomes	1	0	1
ED utilization	1	1	0
Patient experience outcomes reported	2	2	0
Quality of provider care	1	1	0
Quality of health care	1	1	0

SOURCE: Authors' analysis of data from reviewed articles(Beal 2009; Lee 2011; Roby 2010; Berenson 2012)

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NOTES: Studies that were not formally accredited but followed standard components of PCMH were categorized as functional PCMH. Studies that implemented a specific PCMH intervention were categorized as discrete PCMH intervention.

*subcategories in each cell do not necessarily add up to the total number of studies because some studies may have had multiple comparison groups

^subcategories in each cell do not necessarily add up to the total number of studies because each study may have examined multiple disparities

Table 2 summarizes which PROGRESS-Plus characteristic was examined in each study and whether the PCMH intervention had a significant impact on health disparities categorized by NCQA clinical quality measures. Numeric outcomes grouped by individual study can be found in Online Appendix Exhibit 6A.

<i>Table 2. Summary of PROGRESS-PLUS Characteristics and NQMC Clinical Quality Measures Used to Examine Disparities, by Study</i>						
Study Author, Year	PROGRESS-PLUS Characteristic	Process	Access	Outcome	Structure	Patient Experience
Beal, 2009 (22)	Race/ethnicity	✓*				✓*^
	Gender					
	Income status					
	Age					
Berenson, 2012 (23)	Race/ethnicity					
	Gender					
	Income status	✓*	✓*			✓*
	Age					
Lee, 2011 (28)	Race/ethnicity		✓*	✓		
	Gender		✓	✓*		
	Income status					
	Age					
Roby, 2010 (30)	Race/ethnicity			✓*		
	Gender			✓*		
	Income status			✓*		
	Age			✓*		

SOURCE: Authors' analysis of outcomes reported in reviewed articles(Beal 2009; Lee 2011; Roby 2010; Berenson 2012)

✓ Indicates the NQMC clinical quality measure used to examine if a health disparity existed for the PROGRESS_PLUS population characteristic listed. For example, in the Beal study, racial/ethnic disparities were examined by studying differences in process and patient experience outcomes

*Study analysis showed reduction of health disparity for the listed vulnerable population by NQMC outcome

^Reduction in disparity was seen for 2 out of 3 surveyed questions on patient experience with provider quality of care, for which a disparity was observed initially

Process Measures

Comprehensive preventive services are considered proxies for the quality of clinical processes, a tenet of PCMH “whole-person” care (NCQA, n.d.). Two PCMH studies demonstrated reduction of health disparities in health care quality measures related to process of care, specifically preventive care services (Beal et al., 2009; Berenson et al., 2012). One study surveyed a nationally representative population on receiving preventive services and compared low-income (<200% Federal Poverty Level, FPL) and high-income groups (\geq 200% FPL). Interviewees were asked about having received age appropriate screenings that included colon cancer screening, pap smear, mammogram, blood pressure checks, and cholesterol screening. In comparing the total low-income sample to the total high-income sample, the low-income group had a significantly lower rate of preventive screening ($p<0.05$) for all of the preventive care services listed above. When insured, low-income and high-income patients were stratified by having a medical home versus no medical home, differences in screening rates for all of the preventive care were no longer significant between income groups (Berenson et al., 2012).

The second study surveyed a nationally representative population of white and Latino sub-groups (Beal et al., 2009). The study examined self-reports of preventive care, specifically cholesterol screening, blood pressure check, mammography, and prostate-specific antigen screening. When asked about receiving preventive care services, a significant difference was seen between whites, Puerto Ricans, Mexican/Mexican Americans, and Central/South Americans ($p<0.001$). However, when these groups were stratified by no source of care, regular source of care, and medical home, no significant difference among racial/ethnic groups was observed for cholesterol screening in those assigned to a regular source of care ($p=0.13$) or medical home ($p=0.17$). Rates of cholesterol screening were highest for those who had a medical home. Similar patterns of results were reportedly observed for blood pressure checks, mammography, and PSA screening, but not provided in the study.

Access Measures

Another defining component of PCMH is enhancing patients’ access to care (PCMH, n.d.). We found that 2 PCMH studies demonstrated reduction in disparities seen in health care access. One study surveyed a nationally representative population on their perceptions of “cost-related access problems”(Berenson et al., 2012). When comparing the total low-income population (<200% FPL) to the total high-income population (\geq 200% FPL), the low-income group had significantly higher “cost-related access problems” ($p<0.05$). When insured, low-income and insured, high-income patients were stratified by having a medical home versus no medical home and compared to each other, significant differences in “cost-related access problems” were eliminated in both groups. However, when examining each income group independently, those with insurance and a medical home had significantly lower rates of access problems compared to those with insurance and no medical home ($p<0.05$)

The second study examined how a PCMH intervention in the form of a diabetic rapid access program (DRAP) affected access in those with poorly controlled diabetes in community clinics. Days between glycosylated hemoglobin (Hgb A1C) checks were used as a marker of how long patients were engaged with care (Lee et al., 2011). The results showed no significant difference in follow-up time between whites, African Americans, and other ethnic groups indicating no race/ethnic disparities in regards to access with the DRAP program. In contrast, females seemed to have significantly longer follow-up time compared to males ($p<0.0025$), indicating a gender disparity.

Outcome Measures

Clinical outcome measures, such as diabetic glycemic control, can be considered a measure of PCMH's "focus on quality and safety" (NCQA, n.d.; PCMH, n.d.). We found that 2 PCMH studies demonstrated reduction in disparities related to outcomes measures. One study examined the relationship between medical home (MH) assignment and ED visits (Roby & Pourat, 2010). Among those assigned to a MH, no significant difference in having one ED visit was observed among Latinos compared to Non-Hispanic Whites. A protective effect was seen among the Vietnamese group, who had significantly lower odds of having an ED visit compared to whites ($p < 0.001$). However, there was a significant interaction between Vietnamese ethnicity and mental illness, which was associated with increased odds of ER admission ($p < 0.05$).

In this same study, a significant difference between age groups for having an ED visit was also observed (Roby & Pourat, 2010). Younger adults (<55 years old) had significantly higher odds of having an ED visit (1.76, $p < 0.001$), indicating the presence of an age disparity compared to elderly adults. Post-intervention, there were no significant differences seen when comparing genders or income groups for having an ED visit. This study also analyzed the likelihood of multiple ED visits after having MH access (Roby & Pourat, 2010). In these results, there were no statistically significant differences in the likelihood of multiple ER visits among ethnic groups. Furthermore, there was a reduced likelihood of multiple ER admissions among Latinos, Vietnamese, and "other" racial and "unknown" race groups with mental illness.

The second study examined the effect of a functional PCMH intervention in the form of a diabetes program among poorly controlled diabetics (Lee et al., 2011). In this study, a significant difference was seen for average glycosylated hemoglobin (Hgb A1C) between female and males prior to the DRAP program. Post-intervention, a statistically significant difference was no longer found, indicating an improvement in gender disparity. There was no significant difference in Hgb A1C levels between racial/ethnic groups prior to or post-intervention.

Structure Measures

We found no studies demonstrating reduction or elimination in health care quality measures related to structure.

Patient Experience Measures

We found 2 PCMH studies that examined disparities seen with patient experience of care (Beal et al., 2009; Berenson et al., 2012). In the first study, patients were surveyed on their experiences with provider quality of care. Compared to Non-Hispanic Whites and Puerto Ricans, fewer Mexican/Mexican Americans, Puerto Rican and Central/South American patients agreed with the statements "My doctor always or usually explains things", "listens carefully", and "spends enough time" (no tabular data available in manuscript). When stratified by source of care, the differences between ethnicities for those who had a medical home were no longer significant except for the question "My doctor always or usually explains things" (Beal et al., 2009).

The second study, by Berenson et al, was a national survey comparing patients' ratings of the quality of care they received in the past twelve months between low- and high-income groups. When comparing the total low-income population (<200% FPL) to the total high-income population ($\geq 200\%$ FPL), the low-income group rated significantly fewer "very good or excellent" quality of care ($p < 0.05$). When insured, low-income and insured, high-income patients were stratified by having a medical home versus no medical home and compared, income-level differences on ratings of quality of care were no longer significant for both groups (Berenson et al., 2012). However, in the groups of patients with insurance and medical home the rates of

receiving “good or excellent” care were higher than those with insurance and no medical home in both income groups.

CONCLUSIONS

This systematic review is, to the authors’ knowledge, the first comprehensive assessment of the literature on the impact of the PCMH or health homes on health disparities. Notably, only four studies met inclusion criteria. The small number of studies highlights the need for more research critically examining the impact of PCMH and health home interventions, models or transformations on health disparities. If PCMH and health homes continue to be embraced as models for improving the primary care delivery system and continue to have traction in Community Health Center and Medicaid-serving settings, it is imperative that the impact on reducing and/or eliminating disparities is known.

Among included studies, we found preliminary evidence that the PCMH model can reduce or eliminate health disparities in process, access, outcomes and patient experiences based on race/ethnicity, income, age and gender.

Our study has several limitations. First, we included studies published between 2009 and 2014, so we may have missed studies that demonstrated early PCMH or health home benefits, unpublished data, or recently published literature. However, since the PCMH Joint Principles were first articulated in 2007, the NCQA PCMH standards in 2008, and Health Home Criteria in 2012, it is unlikely that many studies would have been completed and published prior to 2009.

The PCMH and health home are models or philosophies of care that remain broadly defined by multiple professional, payer and patient entities. Also, we chose specifically to use PCMH or health homes in our search, and not other variations of the terms. Interventions that are considered under the rubric of PCMH or health homes are complex and multi-factorial, and therefore difficult to compare. Evaluating improvement amidst such heterogeneous interventions is a challenge (Grumbach, 2013). In our study, we allowed for “functional” PCMH or health home definitions, which required components of formal PCMH or health home standards. Future research may allow for more optimal comparisons if formal classifications of PCMH or health homes are used.

We recognize that many safety net settings, where medically underserved, vulnerable or minority patients may receive care, may not be equipped to effectively study these interventions as PCMH or health home transformations and changes are implemented. Additionally, current formal PCMH standards may not comprise the capabilities and services necessary to improve care in low resource environments (Clarke, Tseng, Brook, & Brown, 2012).

Finally, given the small number and heterogeneity of studies that qualified for our final review, conclusions should be interpreted with caution. Searches defined differently or with longer time frames may yield more results.

Although a limited number of studies met our inclusion criteria, the findings are a promising lead for multiple measures of clinical quality affected by the PCMH model. Given the significant investments being made at the federal, state and local level to redesign primary care delivery systems under the model, it is important for multiple stakeholders to align on common strategies for Patient-Centered Medical Homes to measure and achieve health equity. We encourage various stakeholders, as outlined in Table 3, to promote efforts to better understand and demonstrate the impact of PCMH transformations on health disparities, aiming to ultimately reduce or eliminate them.

Table 3. PCMH Stakeholders and Their Role(s) in Understanding/Improving Disparities

PCMH Stakeholder(s)	Potential PCMH-Disparities Opportunity
Grant making organizations	Include disparities-centered outcomes in funding priorities and announcements, and provide support in technical assistance programming
Researchers/Scientists	Improve and implement constructs to better collect and analyze socio-demographic and socioeconomic data in methodology, program development and study design
Accrediting bodies	Consider opportunities to expand newer guidelines and standards to positively impact disparities and capture disparities-specific data
Policy makers	Develop and promote PCMH supportive legislation with demonstrable impact on vulnerable populations, including workforce, financial and practice-based reforms
Primary Care Practices	Utilize electronic or other systems and practice protocols to collect patient-specific socio-demographic and socioeconomic data and design PCMH interventions and programs to address identified disparities
Patients and patient advocacy groups	Engage in practice transformation efforts with primary care practices; encourage collection of comprehensive patient demographic factors; ensure that PCMH interventions/changes have meaningful impact on patients and communities

SOURCE: Authors' conclusions on opportunities for PCMH stakeholders to impact the study and reduction of disparities.

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SUPPLEMENTAL MATERIAL

APPENDIX: METHODS

The objective was to review the empirical evidence on Patient-Centered Medical Home (PCMH) impact on health disparities in adults.

Search Strategy:

From October 2014 to December 2014 we searched PubMed, Scopus, and Google Scholar databases for studies published in English between January 1, 2009 and December 31, 2014. We expanded the search to include health homes in September 2015, using the same reference interval. We used this timeframe to elicit the latest research on PCMH, since the first publication of the NCQA PCC-PCMH standards was in 2008 and Health Homes were formally defined in 2012.

We used several search terms to capture all literature on PCMH and health homes plus health disparities including any of these terms in either the title and/or the abstract. We used the following key search terms: *PCMH, patient centered medical home, health home AND health status disparities, health care disparities OR social determinants of health, health equity, minority health.*

Exhibit 1A provides details of the search strategy used in each database. The systematic review was registered and updated accordingly in the PROSPERO database of the University of York Centre for Reviews and Dissemination (Registration Number - CRD42015019188). Our review utilized the PROGRESS-Plus framework and followed the PRISMA-E 2012 reporting guidelines for systematic reviews with a focus on health equity (V. Welch et al., 2012).

Exhibit 1A. Search Strategy

Search Terms	Search Results	Downloaded to Reference Manager
PubMed		
#1 (Health Status Disparities OR healthcare disparities) AND (patient centered care OR PCMH OR "patient centred medical home" OR "patient centered medical home")	175	175
#2 (social determinants of health OR "health equity" OR minority health) AND (patient centered care OR PCMH OR "patient centred medical home" OR "patient centered medical home")	136	136
#3 (Health Status Disparities OR healthcare disparities) AND "health home"	3	2
#4 (social determinants of health OR "health equity" OR minority health) AND "health home"	1	1
Scopus		
#1 TITLE-ABS-KEY((health status disparities OR healthcare disparities) AND (patient centered care OR pcmh OR "patient centred medical home" OR "patient centered medical home")) AND (LIMIT-TO(PUBYEAR,2014) OR LIMIT-TO(PUBYEAR,2013) OR LIMIT-TO(PUBYEAR,2012) OR LIMIT-TO(PUBYEAR,2011) OR LIMIT-TO(PUBYEAR,2010) OR LIMIT-TO(PUBYEAR,2009))	88	88
#2 TITLE-ABS-KEY((social determinants of health OR "health equity" OR minority health) AND (patient centered care OR pcmh OR "patient centred medical home" OR "patient centered medical home")) AND (LIMIT-TO(PUBYEAR,2014) OR LIMIT-TO(PUBYEAR,2013)	57	56
#3 OR LIMIT-TO(PUBYEAR,2012) OR LIMIT-TO(PUBYEAR,2011) OR LIMIT-TO(PUBYEAR,2010)	3	3
#4 OR LIMIT-TO(PUBYEAR,2009)) TITLE-ABS-KEY ((health status disparities OR healthcare disparities) AND ("health homes")) AND PUBYEAR > 2008 AND PUBYEAR < 2015 TITLE-ABS-KEY ((social determinants of health OR "health equity" OR minority health) AND ("health homes")) AND PUBYEAR > 2008 AND PUBYEAR < 2015	4	4
Google Scholar		

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#1	disparities health care OR status OR healthcare "Patient centered medical home"	3090	195
#2	equity healthcare OR health OR determinants OR minority "Patient centered medical home"	962	144
#3	disparities health care OR status OR healthcare AND "health home"	986	187
#4	equity healthcare OR health OR determinants OR minority AND "health home"	731	145

Combined searches, total = 1136

Duplicates = 172

Records after duplicates removed = 964

Screening Strategy:

Reviewer A, with content knowledge, completed the initial screening of studies by reviewing the title and abstract of each article for relevance to the review objective. Prior to the screening, the reviewer and a senior researcher (reviewer B) performed an inter-rater reliability test ($\kappa > 0.8$) on an adequate random sample of the total searches to demonstrate very good agreement (Exhibit 2A).

Exhibit 2A: Inter-Rater Validity Test (Cohen's Kappa)(Lowry, n.d.)

Reviewer A	Reviewer B		Total
	1	2	
1	61	1	62
2	0	3	3
Total	61	4	65

Agreement	Expected Agreement	Kappa	Std. Err.	Z	Prob>Z
98.46%	89.80%	0.8492	0.1226	6.93	0.0000

Reviewer A then completed the title/abstract screening process and abstracts were included if they met the following inclusion criteria:

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Inclusion:

1. Dates of Publication: 1/1/2009-12/31/2014.
2. Written in English
3. Mention of patient centered medical home or health home in abstract/title AND mention of
 - a. Social determinant(s) of health including PROGRESS-Plus measures (Exhibit 3A) OR
 - b. Patient groups/communities affected by these social determinants of health

If the abstract was unavailable, full text analysis was performed.

Exhibit 3A: Progress-Plus Classification of Vulnerable Populations(Cochrane, n.d.; V. Welch et al., 2012)

PROGRESS	
Place of Residence	Rural/urban, country/state, housing characteristics
Ethnicity	Ethnic background
Occupation	Professional, skilled, unskilled, unemployed etc
Gender	Male or Female
Religion	Religious background
Education	Years in and/or level of education attained, school type
Social Capital	Neighbourhood/community/family support
Socio-economic position (SEP)	Income, means tested benefits/welfare, affluence measures, etc
PLUS	
All SEP	SEP income related, plus occupation, education, and elements of place of residence
Age	Age range
Disability	Existence of physical or emotional/mental disability
Sexual orientation	Heterosexual, gay, lesbian, bisexual, transgender
Other vulnerable groups	School non-attenders, looked after YP, YP in criminal justice system, victims of abuse, runaways, teenage parents

Exclusion:

1. PCMH/Health home in the context of the pediatric population, including adolescents
2. PCMH/Health home studies outside of the United States
3. PCMH/Health home in the context of specialty care such as oncology or psychiatry (outside of primary care)
4. Opinion, editorial, perspective pieces, pictorial, and case studies

We did not impose restrictions on study design with the exception that commentaries were excluded (as stated above), and studies were limited to the United States per review objective. A screening assessment spreadsheet was used to guide selection of relevant studies for the full text screening, and the results of the screening and reason for exclusion were recorded. If reviewer A had any doubt on the relevance of a study, reviewer B reviewed it for inclusion. Abstracts remained on the list if they did not contain sufficient information for a decision for exclusion to be made.

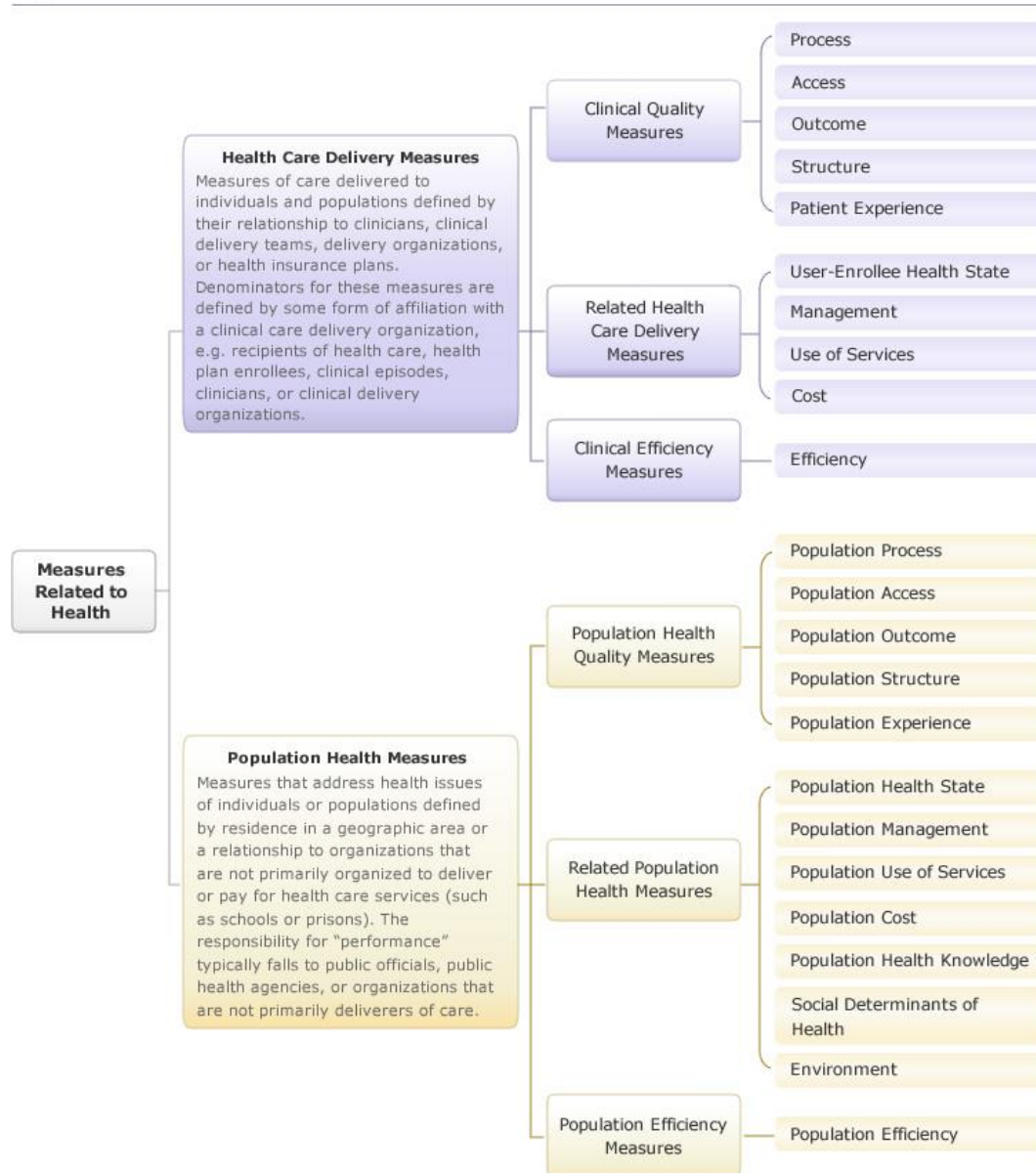
The senior researcher in the field and Principal Investigator on the study (reviewer C) and reviewer A performed full-text screening independently on articles that passed the initial screening using the following full-text screening guidelines:

Full Text Screening:

1. The focus of the studies must be on how a PCMH or health home affects health disparities/health inequities. The intervention studied should be PCMH associated implementation
2. Include studies of any type if they define PCMH or health home using PCMH Joint principles, AHRQ's definition of PCMH, SAMSHA's definition of health home, or other standards of PCMH/health home criteria AND report clinical quality measures in vulnerable populations defined by PROGRESS-Plus (Exhibit 3A)
3. If not formally accredited at time of study, PCMH or health home intervention or criteria must align with PCMH/health home components and involve some change to the usual practice in the clinic setting
4. Interventions delivered to patient populations that meet PROGRESS-plus framework of health disparities (Exhibit 3A)
5. Outcomes include one of the clinical quality measures as defined by National Quality Measures Clearinghouse-Agency for Healthcare Research & Quality (NQMC-AHRQ) including: process, access, outcome, structure, and patient experience (Exhibit 4A)
6. Be conducted among adult primary care patients
7. Diversity in study type allowed, including but not limited to randomized, controlled trials, case-control or observational studies
8. Qualitative studies also eligible if the above criteria met
9. Studies do not require a comparison group
10. Qualitative studies should be included if the above criteria are met
11. Descriptive studies, opinions and commentaries should be excluded

Exhibit 4A: National Quality Measures Clearinghouse Clinical Quality Measure Framework(NQMC, 2015)

NQMC Domain Framework



Excerpt from data abstraction form- interpretation of NQMC Measures:

Process- Process measures are supported by evidence that the clinical process—that is the focus of the measure—has led to improved outcomes- <i>example – the implementation of nurse led standing orders for diabetic foot screening led to an increase in the number of patients with diabetes who had a documented monofilament examination</i>
Access- Access to care is the attainment of timely and appropriate health care by patients or enrollees of a health care organization or clinician – <i>example – the implementation of expanded access through evening hours led to reductions in avoidable ED utilization</i>
Outcome - An outcome of care is a health state of a patient resulting from health care – <i>example- the adoption of a team-based care model for Diabetes led to reductions in HbA1C for Spanish speaking patients</i>
Structure - Structure of care is a feature of a health care organization or clinician related to the capacity to provide high quality health care – <i>example – the practice implemented a telephone HTN management program by RNs and pharmacists based on data that such program improve outcomes</i>
Patient Experience – Experience of care is a patient's or enrollee's report of observations of and participation in health care, or assessment of any resulting change in their health – <i>example – patients in the practice reported higher levels of satisfaction with their ability to see their physician than before the transformation.</i>

Discrepancies in the results were discussed and reviewed until consensus was reached. Articles that met the full text criteria underwent eligibility criteria evaluation. Articles meeting the eligibility criteria were included for data abstraction, using a data abstraction instrument created by the Principle Investigator and reviewed, modified and pilot tested by the study team.

Snowballing:

For completeness, we manually searched citations from 12 pertinent studies that did not meet full inclusion criteria. A total of 12 articles were snowballed (Exhibit 7A). Two reviewers (A and C) independently reviewed the citations in the reference list of each article. These citations underwent title/abstract screening, full text screening, and data extraction as described. Any disagreements were resolved by obtaining a third reviewer's opinion for inclusion or exclusion.

Exhibit 7A: Articles Snowballed

1. Beal A, Hernandez S, Doty M. Latino access to the patient-centered medical home. *J Gen Intern Med.* 2009;24 Suppl 3:514-520. doi:10.1007/s11606-009-1119-1.
2. Berenson J, Doty MMM, Abrams MK, Shih A. Achieving better quality of care for low-income populations: the roles of health insurance and the medical home in reducing health inequities. *Issue Br (Commonw ...* 2012;11:1-18. http://www.healthreformgps.org/wp-content/uploads/1600_Berenson_achieving_better_quality_care_low_income_v2.pdf. Accessed July 30, 2014.
3. Carrillo JE, Shekhani NS, Deland EL, et al. A regional health collaborative formed By NewYork-Presbyterian aims to improve the health of a largely Hispanic community. *Health Aff (Millwood).* 2011;30(10):1955-1964. doi:10.1377/hlthaff.2011.0635.
4. Doty M, Abrams M. Enhancing the capacity of community health centers to achieve high performance. *New York ...* 2010. <http://www.worh.org/files/CAH-CHC-Report8-12-10.pdf>. Accessed October 23, 2014.
5. Ferrer RL, Gonzalez Schlenker C, Lozano Romero R, et al. Advanced primary care in San Antonio: linking practice and community strategies to improve health. *J Am Board Fam Med.* 2013;26(3):288-298. doi:10.3122/jabfm.2013.03.120238.
6. Findley S, Matos S, Hicks A, Change J RD. Community health worker integration into the health care team accomplishes the triple aim in a patient-centered medical home: a Bronx tale. *J Ambul Care Manage.* 2014;37(1):82-91. <http://www.ncbi.nlm.nih.gov/pubmed/24309397>. Accessed October 7, 2014.
7. Grant R, Greene D. The health care home model: Primary health care meeting public health goals. *Am J Public Health.* 2012;102(6):1096-1103. doi:10.2105/AJPH.2011.300397.
8. Lebrun-Harris LA, Shi L, Zhu J, Burke MT, Sripipatana A, Ngo-Metzger Q. Effects of patient-centered medical home attributes on patients' perceptions of quality in federally supported health centers. *Ann Fam Med.* 2013;11(6):508-516. doi:10.1370/afm.1544.
9. Lee K, Palacio C, Alexandraki I, Stewart E, Mooradian AD. Increasing access to health care providers through medical home model may abolish racial disparity in diabetes care: evidence from a cross-sectional study. *J Natl Med Assoc.* 2011;103(3):250-256. <http://www.ncbi.nlm.nih.gov/pubmed/21671528>. Accessed July 30, 2014.
10. Roby D, Pourat N. Impact of patient-centered medical home assignment on emergency room visits among uninsured patients in a county health system. *Med Care Res Rev.* 2010. <http://mcr.sagepub.com/content/early/2010/05/24/1077558710368682.abstract>. Accessed October 23, 2014.
11. Schmidt L, Rittenhouse D, Wu K, Wiley J. Transforming primary care in the New Orleans safety-net: the patient experience. *Med Care.* 2013. <http://journals.lww.com/lww->

medicalcare/Abstract/2013/02000/Transforming_Primary_Care_in_the_New_Orleans.7.aspx. Accessed October 23, 2014.

12. Unützer J, Harbin H. The collaborative care model: An approach for integrating physical and mental health care in Medicaid health homes. *Heal HOME*, 2013.
http://www.mdcbh.org/images/HH_IRC_Collaborative_Care_Model_052113.pdf.
Accessed September 8, 2015.
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Study Quality:

Those studies that underwent data abstraction were also assessed for quality. Two reviewers independently applied 16 quality criteria that were common sets of criteria proposed by research groups for non-experimental data. Discrepancies in results were discussed and resolved. The quality criteria was deemed appropriate because it covered a range of important areas pertaining to quantitative non experimental data including descriptions, sampling, measurement, data analysis, and interpretation of results. We used a 16-point scoring system, assigning one point for each of 16 quality sub-domains. Studies scoring 14-16 were deemed excellent in quality, 10-13 were deemed good, 7-9 were deemed fair, and <7 were deemed poor.

Data extraction:

We used a standardized data collection instrument to systematically extract information related to study design and key findings. The data abstraction form, adapted from a systematic review data collection tool published by Zaza et al, included sections on study type, eligibility, study characteristics and participants, PROGRESS-Plus criteria, outcomes, results, limitations and scientific quality (Zaza et al., 2000).

One researcher with content knowledge (reviewer A) abstracted the data from the eligible studies and organized data into a data summary table used for synthesis. A second senior reviewer with expertise (reviewer B or C) independently completed the data abstraction form and findings were discussed with reviewer A. Disagreements were resolved by discussion and resolution of issue or by obtaining a third reviewer's opinion if the first two reviewers could not reach consensus. In all cases, consensus was reached.

Data Synthesis:

We characterized studies by study design, study population, and outcomes. All studies happened to be quantitative, but given the heterogeneity of the study designs, interventions, and disparities examined, a meta-analysis was not possible. Instead, we synthesized a comparative study characteristics table to describe the type of studies that have been performed. Studies were thematically grouped into domains of “disparity assessed” based on study population, and into domains relating to one of five clinical quality measures.

For analytic purposes, we focused on whether statistical differences on clinical quality outcomes seen in two comparison groups were significant ($p < 0.05$). Those groups who showed a significant difference indicated the presence of disparity. Those groups who showed no significant difference in the clinical quality outcome indicated a reduction in disparity.

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Exhibit 5A. Characteristics of Included Studies

Study, Year (Reference)	Study Design/Project Aim	PCMH Components Described in Study*	Disparities Studied	Setting and Population	Participants, n	Outcomes Reported	Duration of Study	Study Quality Score †
Beal et al, 2009(Beal et al., 2009)	Cross-sectional observational study. Analysis of data from telephone survey comparing self reported patient care services among Latinos with medical home, regular source of care, or no regular source of care.	Regular provider Provider's role in total care Patient engagement in care Care accessibility	Race/Ethnicity	National Medical Expenditure Survey 2005 (MEPS) surveying 25,000 adults (>18) with oversampling of Latinos (6,200)	Adults, 24,000 Sub-population: 6,200 Latinos	Process of care, Patient Experience	NA	13 (Good)
Berenson et al, 2012(Berenson et al., 2012)	Cross-sectional observational study. National population based cross sectional survey to assess perceptions of health care when insured and having a medical home.	Regular provider/place of care Ease of contacting provider by phone Provider knows important information about patient health Regular provider helps to coordinate care with other doctors	Income, Insurance	The Common Wealth Biennial Health Insurance Survey 2010) of randomly selected sample of adults.	Adults, 4,005	Process of care, Access, Patient Experience	NA	11 (Good)

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Exhibit 5A. Characteristics of Included Studies

Study, Year (Reference)	Study Design/Project Aim	PCMH Components Described in Study*	Disparities Studied	Setting and Population	Participants, n	Outcomes Reported	Duration of Study	Study Quality Score †
Lee et al, 2011(Lee et al., 2011)	Quasi-experimental quantitative controlled before-after cohort study to see how medical home assignment improves the quality of and access to diabetes care.	Whole person orientation Care is coordinated and integrated Enhanced access Quality and safety	Race/ethnicity Gender	Adult Type 2 diabetics enrolled in urban community based health initiative (Diabetes Rapid Access Program) in Jacksonville, Florida	Adults with Type 2 Diabetes Mellitus, 457	Clinical outcome (Hgb A1C) Access	Outcomes based on various measures taking over the course of 3.5 y	13 (Good)
Roby et al, 2010(Roby & Pourat, 2010)	Cross-sectional observational study using claims data to analyze the relationship between medical home assignment and Emergency Department use.	Maintains person's medical information Provides primary medical care and prevention services Licensed provider of health services	Race, Age, Gender, income	Uninsured, low income adult population enrolled the Medical Services Initiative Program (public program) in Orange county seeking care in privately contracted safety net system.	Adults, 2,708	Utilization outcomes (ED Visits)	Estimates based on 2.5 y data	13 (Good)

PCMH = patient centered medical home

* None of the settings had formal recognition as a PCMH site

† Study Quality(Zaza et al., 2000): 14-16 (Excellent); 10-13 (Good); 7-9 (Fair); < 7 (Poor)

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Exhibit 6A. Reported Outcomes by Study

Study, Year (Reference)	Type of Study	PCMH Criteria explicitly stated?	Population	Quality	Outcome Category	Outcome	Results
Beal et al, 2009(Beal et al., 2009)	Cross-sectional	Yes	Latino Adults (>18)	Good	Process:	Preventive Services: Cholesterol Screening	<i>% of ethnic population receiving cholesterol screening^{HL}</i> → All RC MH NC W: 70 70 79 41 MA: 56 65 76 34 PR: 74 70 83 50 CSA: 65 77 82 48 P: <.001 0.17 0.13 0.002
					Patient experience:	Quality of provider care: explained things so you understood	<i>% reporting that doctor always or usually explains things^{HO}</i> → All RC MH NC W: 93 89 95 89 MA: 89 83 93 86 PR: 86 83 90 70 CSA: 86 87 88 82 P: <.001 <0.02 0.001 <0.03
Berenson et al, 2012(Berenson et al., 2012)	Cross-sectional	Yes	Adults (19-64)	Good	Patient experience:	Rated Quality of health care as good or excellent in past 12 months	<i>Given as % of adults ages 19-64 comparing income status^H</i> → Total I+NMH I+MH FPL< 200% 35 34 54 FPL>200% 54 48 70 P: <0.05 NS NS
					Process:	Reported receiving all preventive screenings	→ Total I+NMH I+MH FPL< 200% 36 44 52 FPL>200% 59 59 65 P: <0.05 NS NS
					Access:	Had at least one cost-related access Problems	→ Total I+NMH I+MH FPL< 200% 54 50 35

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Exhibit 6A. Reported Outcomes by Study

Study, Year (Reference)	Type of Study	PCMH Criteria explicitly stated?	Population	Quality	Outcome Category	Outcome	Results
							FPL>200% 34 38 22 <i>P:</i> <0.05 NS NS
Lee et al, 2011(Lee et al., 2011)	Prospective Cohort	No	Adults Type 2 Diabetes (>18)	Good	Outcome: Biophysical marker	Hgb A1C Gender:	Mean A1C: Baseline Follow up → Male 8.2 7.7 Female 8.1 7.9 <i>P:</i> 0.011 NS
						Race/Ethnicity	→AA 8.4 7.9 White 8.1 7.4 Other 8.5 7.7 <i>P:</i> NS NS
					Access: Duration of follow up	Average days between A1C measurements	Days of follow up → Male 471 Female 549 <i>P:</i> 0.0025 → AA 527 White 520 Other 451 <i>P:</i> NS
Roby et al, 2010(Roby & Pourat, 2010)	Cross-sectional	Yes	Adults (>18)	Good	Outcomes: Utilization	Having any ED visit Race/Ethnicity compared to White Significant Interaction between ethnicity and mental illness Outcomes: Utilization Age compared to oldest age group >54 Compared to	<i>Odds ratio for independent variables predicting having ER visit among those assigned to a MH (95% CI)</i> →Vietnamese 0.19 (<i>P</i> <0.001) →Latino 0.74 NS → Vietnamese + Mental Illness 2.41 (<i>P</i> <0.05)

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Exhibit 6A. Reported Outcomes by Study

Study, Year (Reference)	Type of Study	PCMH Criteria explicitly stated?	Population	Quality	Outcome Category	Outcome	Results
						Males Compared to higher income	→Age 22-44 2.37(<i>P</i> <0.001) →Age 45-54 1.82(<i>P</i> <0.05)
						Having multiple ED visits (see above for comparison group)	→Female: 0.93 (NS) →FPL: ≤ 100%: 0.97 (NS)
							<i>Negative Binomial Logistic Regression Results</i> →Vietnamese 0.92 (NS) →Latino 1.16 (NS) →Age 22-24 1.76(<i>P</i> <0.001) →Age 45-54 1.26(<i>P</i> <0.001) →Female 0.84(<i>P</i> <0.01) →FPL ≤100 % 1.23(<i>P</i> <0.001) →Latino + Mental Illness 0.67(<i>P</i> <0.01) →Vietnamese+ Mental Illness 0.44(<i>P</i> <0.001) →Other Race+ Mental Illness 0.21(<i>P</i> <0.001)

PCMH = patient centered medical home; MH= medical home; FPL=Federal Poverty Level; CI=Confidence Interval; *P*= p-value

NS=not statistically significant

Bolded text indicates a reduction in disparity between comparison groups

‡ W: White MA: Mexican/Mexican American PR: Puerto Rican CSA: Central/South American RC: Regular source of care MH: Medical Home NC: No regular source of care

Ⓛ Similar pattern was seen for the other preventive measures of blood pressure checks, mammography, and prostate cancer (PSA) screening

ΩWhen stratified by medical home, reduction in disparity was seen for 2 out of 3 surveyed questions (for which a disparity was seen initially) on patient experience with provider quality of care (data on these measures not available)

μ I+NMH=insured +no medical home; I+MH=insured with medical home