



**DRIVERS
OF HEALTH**



INTERVENTIONS IN HOUSING, EDUCATION, AND HEALTH CARE ACCESS AND QUALITY:

A Literature Review

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1.0 Introduction

At the convening of our project advisory committee in Princeton, we were directed to examine the most recent literature reviews (published within the last five years) of the effects on health of interventions on housing, education, and health care access and quality. We were asked to assess the extent to which reviews addressed the following issues: health outcomes, populations of study, static vs. dynamic factors, actionability, robustness, authenticity, return on investment, and evaluation of what has not been covered in the literature.

For practical reasons, we deviated from this request in two ways. First, we simplified the assessment of health care access and quality by focusing specifically on access interventions related to expanding insurance coverage and quality interventions that may have precipitated decreases in cardiovascular mortality. Second, some of these recommended focus issues proved challenging to operationalize or warranted broadening. We modified them to the following categories, which we used to evaluate each review: health outcome of focus, return on investment,^a types of studies, populations of study, implementation, and level of evidence/study quality. We conducted a broad literature search using Google Scholar and PubMed, consulted experts in the areas of focus, and looked at papers that cited, and were cited by the ones we initially included.

Across these broad categories we evaluated—housing, education, and health care—there is an important distinction between *more* and *improved quality*. Examples that illustrate these distinctions are included in the table below.

Area	Example of “more”	Example of “better quality”
Housing	New housing units or more affordable housing	Removing lead from homes or increasing ventilation
Education	An additional year of schooling	More effective educational practices
Health care	Improved access to health care	More effective treatments

^aOf note, as we were finishing up this draft, we became aware of a recent National Academy of Medicine report on a workshop on social investments that included a session on return on investment. One of the conclusions of the panel was that more studies of ROI are needed (Martinez and Alper, National Academies of Sciences, Engineering, and Medicine, 2019).



2.0 Housing

2.1 Background

It is well documented that housing is closely associated with health. Housing intersects a multitude of upstream factors that indirectly affect health, and it encompasses many environmental and social factors that directly affect health. Housing status is influenced by legacies of racism, classism, and xenophobia which compromise access to safe, protected spaces that can facilitate health. Unstable and inadequate housing contributes to stress and presents barriers to establishing social support and accessing resources and opportunities that promote health.¹

Historically, improvements in housing significantly reduced the spread of communicable diseases like typhoid and tuberculosis in the 19th and 20th centuries; the reductions in household crowding and improved sanitation via indoor plumbing, smooth indoor surfaces that could be cleaned, food preservation techniques, and ventilation were all powerful contributors to ameliorating these epidemics.²

In the 21st century, as the public health focus has largely turned from communicable diseases to chronic ones, such as asthma, cancer, lead poisoning, and mental health disorders, the housing-health association remains significant.² People experiencing homelessness are much more likely to suffer from mental illnesses and substance use disorders.^{3,4} Homelessness is particularly detrimental for children,⁵ and the combination of motherhood and homelessness is harmful to the mental health of mothers and associated with higher rates of substance use.⁶ But, just having a home is not enough. Housing quality is also important for health. Risk factors within the home, like lead paint or presence of dust mites, impact health, especially for children.⁷

Still, even recognizing that links exist between housing and health is not enough to improve health. While the body of literature on housing interventions and their effectiveness is somewhat limited, we reviewed recent summaries of housing interventions to assess what is known about how, and if, they work. The table below summarizes our findings, followed by a more detailed description of each review.

2.2 Summary

From the literature summarized below, we have drawn the following, high-level conclusions:

- There is broad consensus that, in general, increasing housing affordability, access, and quality has positive health outcomes.
- The literature lacks evidence of robust return on investment.
- The most consistent and strongest health results documented in the literature are:
 - Interventions aimed at providing housing for people experiencing homelessness (including Housing First) are linked to increased stability, housing retention, wellbeing, health outcomes, and health access;
 - Repairs and improvements to housing aimed at reducing and managing asthma symptoms in some populations (Sauni et al. 2015) and increasing warmth and efficiency (Thomson et al. 2013) were associated with health improvements;
 - Multi-faceted, integrated models of housing, have been shown to produce stronger, longer-lasting health effects than intervention components implemented in isolation.
- Authors of reviews recommend additional research in the following areas:



- More targeted research on sub-populations experiencing substandard housing, housing instability, or homelessness concurrent with other health issues in a wider range of locations (e.g., children, veterans, women, minority groups and in locations outside of North America);
- More research into a wider range of health outcomes, particularly those that are less well-understood and less frequently studied (e.g., psychiatric symptoms and substance use);
- Long-term effect of the housing interventions under study (e.g., earnings, employment, substance use, prevalence of chronic disease);
- Effectiveness of interventions in isolation when they are not implemented as part of a multi-faceted approach (e.g., integrated approaches to reduce asthma symptoms have been shown to be effective but the effectiveness of reducing a single exposure to asthma triggers needs more investigation);
- Interaction between individual vulnerabilities and broader determinants of health, accounting for historical and political context to help understand the roots of these issues (e.g., how legacies of redlining and blockbusting may interact with chronic homelessness, substance use, and unemployment).



2.3 Tabular Summary of Review

Paper	Populations studied	Health outcomes of focus	Types of studies	Housing/ higher-quality housing	Major Findings	Return on Investment (ROI)
Aidala AA, Wilson MG, Shubert V, et al. Housing Status, Medical Care, and Health Outcomes Among People Living with HIV/AIDS: A Systematic Review. <i>AJPH</i> . 2016; 106(1):e1-e23.	HIV positive patients in the US, Canada, France, Spain, Italy, Finland, South Korea	Health care access and utilization, ARV adherence, clinical health outcomes, risk behavior	2 RCTs, 64 longitudinal studies, 86 cross-sectional studies	Both	Improved housing is linked to better health outcomes as well as improved access.	Public spending on housing interventions for people with HIV was shown to be cost-effective or cost-saving in the RCTs included in the review
Fitzpatrick-Lewis D, Ganaan R, Krishnaratne S, et al. Effectiveness of interventions to improve the health and housing status of homeless people: a rapid systematic review. <i>BMC Public Health</i> . 2011;11:638.	People experiencing homelessness in any country	Substance use, mental health outcomes, health care utilization, risk behaviors	RCT, quasi-experimental, observational	Housing	Coordinated treatment programs for people experiencing homelessness and mental illness or substance use disorders results in better health outcomes and access to care.	No discussion of return on investment
Jacobs DE, Brown MJ, Baeder A, et al. A Systematic Review of Housing Interventions and Health: Introduction, Methods, and Summary Findings. <i>Journal of Public Health Management and Practice</i> . 2010;16(5):S5-S10.	Recipients of housing interventions (no restrictions on location)	Two broad categories of evidence: clinical evidence and environmental measurements	Longitudinal and cross-sectional studies	Higher-quality housing	Specific interventions were shown to be associated with improved health outcomes (e.g. Housing Choice Voucher Program, isolation pool fencing).	No formal evaluation of ROI, but authors identified interventions that are likely to yield a positive return
Krahn J, Caine V, Chaw-Kant J, et al. Housing interventions for homeless, pregnant/parenting women with addictions: a systematic review. <i>Journal of Social Distress and the Homeless</i> . 2018;27(1):75-88.	Pregnant/parenting women experiencing homelessness and using substances in the United States	Housing stability, maternal mental health, children's mental health, substance use	Cross-sectional, longitudinal, RCT, quasi-experimental	Housing	Insufficient evidence to conclude that certain interventions are better than others, however the Housing First approach showed promising results.	No discussion of return on investment



Paper	Populations studied	Health outcomes of focus	Types of studies	Housing/ higher-quality housing	Major Findings	Return on Investment (ROI)
Latimer EA, Rabouin D, Cao Z, et al. Cost-effectiveness of Housing First Intervention With Intensive Case Management Compared With Treatment as Usual for Homeless Adults With Mental Illness. JAMA Netw Open. 2019;2(8):e199782.	Homeless individuals with mental illness	Days of stable housing	Economic evaluation of RCT	Stable housing	Scattered-site Housing First (HF) intervention with intensive case management (ICM) was more effective than treatment as usual.	Cost per additional day of stable housing was on par with previously tested interventions for homeless individuals and expanding access to HF with ICM is a cost-effective intervention.
Sauni R, Verbeek JH, Uitti J, Jauhiainen M, et al. Remediating buildings damaged by dampness and mould for preventing or reducing respiratory tract symptoms, infections and asthma. Cochrane Database of Systematic Reviews 2015, (2):1-76.	Children and adults in buildings damaged by water or mold in the US, UK, Finland, Sweden, Ireland, and New Zealand	Respiratory tract infections, asthma and associated symptoms, allergic alveolitis	RCT, cRCT, controlled before-after	Higher-quality housing	Improving housing damaged by dampness reduces asthma-related symptoms in adults.	A conservative cost-benefit analysis of the interventions evaluated in one study suggests that intervention benefits outweigh the costs by two-fold.
Slopen N, Fenelon S, Newman S, et al. Housing Assistance and Child Health: A Systematic Review. Pediatrics. 2018;141(6):e20172742.	Children in the U.S. who benefited from interventions involving public housing, multifamily housing, or housing vouchers.	Child mental or physical health, violence and health behaviors	Longitudinal and cross-sectional (29% of studies were quasi-experimental and 71% were association)	Higher-quality housing (housing assistance)	The relationship between housing assistance and health is unclear.	No discussion of return on investment
Thomson, H, Thomas S, Sellstrom E, Petticrew M. Housing Improvements for Health and associated socioeconomic outcomes. Cochrane Database of Systematic Reviews. 2013;2:CD008657.	Children and adults from any region of the world who received some sort of housing aid or intervention	General health outcomes, respiratory health, mental health, and other health related outcomes and behaviors	RCT and non-experimental	Higher-quality housing	Warmth and energy efficiency housing improvements are associated with improved health and social relationships.	Some warmth improvements may result in benefits that outweigh the cost of implementation, according to the results of two New Zealand RCTs included in the review.



Paper	Populations studied	Health outcomes of focus	Types of studies	Housing/ higher-quality housing	Major Findings	Return on Investment (ROI)
Woodhall-Melnik JR, Dunn JR. A systematic review of outcomes associated with participation in Housing First programs. Housing Studies. 2016;31(3):287-304.	Homeless population with psychiatric symptoms, addictions, and/or concurrent disorders	Substance use and psychiatric symptoms, service use and costs, quality of life	RCT and observational studies	Housing	Results are mixed on whether Housing First impacts psychiatric symptoms or substance use; increased housing retention is associated with Housing First.	Evidence suggests that cost reductions were associated decreased ED use, inpatient hospitalizations, and engagement with the criminal justice system, outcomes all linked to HF, though these findings are not consistent across all studies reviewed.



2.4 Review of Literature

Aidala AA, Wilson MG, Shubert V, et al. Housing Status, Medical Care, and Health Outcomes Among People Living with HIV/AIDS: A Systematic Review. *AJPH*. 2016; 106(1):e1-e23.

Methodology

Authors Aidala et al. searched eight electronic databases from 1996 to 2014 for articles that examined housing status and how it relates to health outcomes for HIV positive patients, specifically examining health care access and utilization, ARV adherence, HIV clinical health outcomes, other health outcomes, ED visits or inpatient stay, and HIV risk behavior. While Aidala et al. did not explicitly conduct a review of interventions, nine of the studies they reviewed evaluated the effectiveness of an intervention. Two independent reviewers controlled for the quality of the studies included. Their search returned 152 studies deemed “good” or “fair” on all quality assessment ratings. Of these, two studies were randomized controlled trials, 64 were longitudinal studies, and the remaining 86 were cross-sectional studies. The majority (112 studies) examined US populations, while 27 examined HIV positive patients in Canada, and the remaining 13 studied populations in France, Spain, Italy, Finland, and South Korea.

Level of Evidence/Study Quality

The authors conducted quality assessments of each included study. They used the Cochrane Risk of Bias Tool to categorize randomized controlled studies as having low, unclear, or high risk of bias. They used the Newcastle Ottawa Quality Assessment Tool to categorize the quality of nonintervention studies.⁸ In reviewing the quality of observational studies, the authors assessed universal issues of quality, e.g., employing an appropriate protocol for measuring the exposures and outcomes. Within these study classifications—RCT, nonintervention, and observational—each study was assigned a rating of good, fair, or poor.

Studies were considered “good” if they employed a definition of housing status deemed “clear and replicable” and that referenced at least one component of housing (e.g., dwelling context, personal assets, housing quality) and time specifier (e.g., within the last 6 months). Outcomes were considered “good” if they used objective measurements or “validated self-reported measures.” The method to control confounding factors was rated “good” if they adjusted for confounding factors and included at least one indicator of socioeconomic status and one of behavioral health.

Major Findings

The studies Aidala et al. included indicated that worse housing “is associated with poorer access to and engagement in health care and treatments, lower adherence to ARV therapy, worse health outcomes, and higher rates of HIV risk behaviors.” They report that the two RCTs they reviewed, both of which studied housing interventions for people experiencing homelessness, found that improved housing status resulted in significant reductions in health care utilization and improved health status. In one of the RCTs, a year after the intervention implementation, the intervention group was more likely to be alive with intact immunity and lower viral loads. Among the other that were not randomized controlled designs, Aidala et al. found that interventions that link people to stable housing result in increased likelihood to engage with primary care, increased viral load suppression, lower likelihood of substance use, and higher quality of life.



Implementation

No discussion of intervention implementation.

Return on Investment

The authors of this review did not explicitly measure ROI for the interventions examined. However, they noted that evidence from the two randomized controlled trials they included, both of which relied on Housing First approaches, indicates that public spending on housing interventions for people with HIV is cost-effective or cost-saving after accounting for reductions in avoidable health care spending and HIV infections.

New Research Recommended

The authors concluded that the evidence from the RCTs and observational studies they reviewed indicate that housing assistance has an independent, significant effect on improving health outcomes for people with HIV who were previously living in substandard housing. However, they also noted that more research is necessary to understand the complex interaction between individual vulnerabilities and much broader determinations of health, between which housing lies at the juncture.

Fitzpatrick-Lewis D, Ganaan R, Krishnaratne S, et al. Effectiveness of interventions to improve the health and housing status of homeless people: a rapid systematic review. BMC Public Health. 2011;11:638.

Methodology

Authors Fitzpatrick-Lewis et al. conducted a literature search of five electronic databases (PsycINFO, OVID, HealthStar, CINAHL, and Sociological Abstracts) for articles published between 2004 and 2009 that evaluated the effectiveness of interventions aimed at improving the health of people experiencing or at risk of homelessness. The authors did not restrict their search by location, however they only included papers published in English. The authors included studies if they prospectively compared homeless individuals who received an intervention with those who received standard care or another intervention and examined relevant outcomes (including different measures of health, access to health services, and housing status). Studies that used the following designs were included in the review: randomized controlled trials, controlled clinical trials, analytic cohort studies, case control studies, and observational cohorts.

Level of Evidence/Study Quality

Although 84 studies were identified, none were classified as presenting evidence of “strong quality.” Ten were classified as “moderate quality.” Authors used a tool for study appraisal developed by the Effective Public Health Practice Project.⁹ Using this tool, each study was evaluated on six criteria—selection bias, study design, confounders, blinding, data collection methods, and withdrawals and dropouts—and ranked from “strong” to “weak” in each of these dimensions.

Major Findings

Based on the literature they reviewed, the authors conclude that integrated models of housing provision appear to be the most effective model for promoting long-term housing and increasing utilization of health care services for patients experiencing chronic illness.



The authors also conclude that for people who are experiencing homelessness or unstable housing and substance use disorders, housing contingent on abstinence was associated with better outcomes than when no housing was provided.

Implementation

The authors comment that there is a lack of awareness and implementation of interventions that have been demonstrated to have positive health and housing outcomes, yet they do not evaluate the implementation of the interventions evaluated in the studies they review.

ROI

The authors do not comment on any potential cost-implications of the interventions they reviewed.

New Research Recommended

Fitzpatrick-Lewis et al. identify gaps in the literature where more research is needed, particularly within sub-populations of people experiencing homelessness, such as women, families, and children—groups that are underrepresented in the literature. The authors also explain that since homelessness is associated with a number of chronic diseases including HIV/AIDS, tuberculosis, schizophrenia, diabetes, and hepatitis C, it is critical that more research be conducted into interventions aimed at populations experiencing these conditions.

Jacobs DE, Brown MJ, Baeder A, et al. A Systematic Review of Housing Interventions and Health: Introduction, Methods, and Summary Findings. *Journal of Public Health Management and Practice*. 2010;16(5):S5-S10. Part of a supplement with four additional sections focused on each of the four identified interventions

Methodology

Authors Jacobs et al. identified a diverse panel of non-government researcher-experts who then conducted a MEDLINE literature search for articles between 1990 and 2007 that examined four types of interventions: interior biological agents interventions, interior chemical agents interventions, structural deficiency interventions, and community-level interventions. The following search terms were used, guided by the committee: public housing; housing; home; intervention studies; health effects; mitigation; program evaluation; primary prevention; clinical trials; randomized controlled trials; and domestic. These studies reviewed the effects of housing on health outcomes for people who were recipients of housing interventions by examining two broad categories of evidence: clinical evidence and environmental measurements.

Level of Evidence/Study Quality

One to two panelists reviewed each study, rating them on a 5-point scale on the following factors: design/suitability, execution, study size and population, overall value, and direction of effect and degree of impact. Then each intervention was classified as falling into one of the following four categories: sufficient evidence, needs more field evaluation, needs formative research, or no evidence of effectiveness.

The authors classified interventions as “successful” if they reduced the levels of exposure that have been shown to negatively affect health through a dose-response relationship.



Major Findings

The authors concluded that 11 of the interventions they reviewed have sufficient evidence of effectiveness, 15 require more field evaluation, 19 need formative research, and 7 do not exhibit any evidence of effectiveness. Based on findings that the Housing Choice voucher holders are less likely to experience overcrowding, malnutrition, and poverty, Jacobs et al. recommended expansion of the Housing Choice Voucher Program.¹⁰ They also concluded that the following interventions are effective and call for their expansion: interventions to improve home safety (e.g. smoke alarms, isolation pool fencing, hot water heaters that are pre-set to a safe temperature), interventions to reduce chemical exposures in the home, and interventions to reduce asthma (e.g. in-home tailored interventions, pest management, and elimination of moisture).

Implementation

Jacobs et al. reported that studies that did not incorporate multi-faceted approaches are far less successful and that individually tailored multi-faceted housing-based interventions are most successful in improving clinical outcomes, especially with respect to reducing asthma. They also suggested that in order to more successfully implement housing interventions, it is necessary to improve mobility programs.

ROI

The authors did not explicitly state any returns on investment, yet they identified which interventions are likely to yield a positive return (asthma interventions, cockroach control to reduce allergens, elimination of moisture and mold, radon reduction, pesticide reduction, smoke-free policies, lead hazard control, smoke alarms, pool fencing, safe hot water heaters, and rental vouchers) and which are not successful (bedding encasement and upholstery cleaning alone, acarides alone, air cleaners releasing ozone, professional cleaning to reduce lead exposure, three sided pool fencing).

New Research Recommended

The authors recommended that all those interventions they classify as “needs more field evaluation” or “needs formative research” necessitate further investigation.

Within the category of interior biological agents, Jacobs et al. reported that improved insulation, repeated vacuuming and steam cleaning, HEPA air filtration, and ventilation and dehumidification need more field evaluation, and one-time professional cleaning needs more formative research.

In the category of interior chemical agents, radon mitigation in drinking water, portable HEPA cleaners, attached garage sealing and other VOC interventions, residential ventilation, and particulate control by envelope sealing require more evaluation and research.

The following structural deficiencies interventions necessitate more research and evaluation: fall prevention by home modification, temperature-controlled mixer faucets, safe ignition sources, home modification for fire escape, functional air conditions, automatic fire sprinklers, pool covers and alarms, carbon monoxide prevention, enforcement of building and housing codes, and noise reduction.

Finally, the authors enumerated the following community-level housing interventions that need more research: moving people from high-poverty to low-poverty neighborhoods, demolition and revitalizing of poor public housing, design improvements to reduce crime and promote health, zoning, green space around housing.



Krahn J, Caine V, Chaw-Kant J, et al. Housing interventions for homeless, pregnant/parenting women with addictions: a systematic review. Journal of Social Distress and the Homeless. 2018;27(1):75-88.

Methodology

The authors searched electronic databases to identify studies on housing models for homeless pregnant and/or parenting women with addictions using the following key terms: “substance use”, “homelessness”, “motherhood and/or pregnancy.” All studies were conducted in the United States. The authors evaluated a range of health outcomes measured across the various studies, but focused primarily on housing stability, maternal mental health, child mental health, substance use, and parenting. The studies reviewed employed a range of methods, including cross-sectional, longitudinal, randomized controlled trial, and quasi-experimental designs. The authors included studies published from 2004 to 2016.

Level of Evidence/Study Quality

The authors followed PRISMA guidelines to achieve maximal rigor.¹¹ They included only four studies in their review.

Major Findings

The authors concluded that there is not enough evidence to determine the best housing program for homeless, pregnant/parenting women using substances. The authors did, however, report that the most rigorous, up-to-date studies they examined evaluated Housing First programs¹² combined with case management and that these strategies in tandem are associated with positive impacts for the population under study.

Implementation

No commentary on implementation in the discussion section.

ROI

The authors did not report any ROIs for the interventions they reviewed, but they reported that some of the studies they reviewed examining rapid access to housing may have cost implications that, at least in part, offset the costs of the intervention, largely by lessening the cost-burden of shelter stays.

New Research Recommended

The authors highlighted the overall lack of research on housing programs for pregnant/parenting women experiencing homelessness and using substances. The authors raised concerns about the efficacy of many U.S. programs when the evidence to support them is so sparse.

Sauni R, Verbeek JH, Uitti J, Jauhiainen M, Kreiss K, Sigsgaard T. Remediating buildings damaged by dampness and mould for preventing or reducing respiratory tract symptoms, infections and asthma. Cochrane Database of Systematic Reviews 2015, (2):1-76.

Methodology

Sauni et al. searched eight electronic databases (CENTRAL, MEDLINE, EMBASE, CINAHL, Science Citation Index, Biosis Previews, NIOSHTIC, and CISDOC) for studies that focused on interventions on the



remediation of damp buildings, spanning time periods from the 1970s to 2014. The authors reviewed a total of 12 studies, which were conducted in the U.S., U.K., Finland, Sweden, Ireland, and New Zealand. These studies focused on the effects of interventions in buildings that had been damaged by water or mold on children and adults, observing health outcomes in the following four categories: respiratory symptoms, respiratory infections, allergic alveolitis, and asthma-related outcomes or symptoms. These studies also spanned a range of methodological designs, including two randomized controlled trials, one cluster RCT (cRCT), and 9 controlled before/after studies (prospective cohort studies).

Level of Evidence/Study Quality

Two reviewers independently reviewed each study to determine if it met the criteria for inclusion or exclusion. Two reviewers subsequently evaluated RCT and cRCT study quality using the “Risk of Bias” tool recommended by the Cochrane Handbook for Systematic Review of Interventions.¹³ The authors determined that of the studies they reviewed, evidence quality ranged from “very low” to “moderate.”

Major Findings

The authors found that, for adults, repairing houses decreased asthma-related symptoms, yet there was no difference in asthma days or ED visits for children based on whether their houses were repaired or whether they received information on cleaning to reduce allergies and symptoms.

Implementation

No discussion of implementation of interventions.

ROI

The authors report that one of the studies they included in their review conducted an economic evaluation suggesting that a small investment in building remediation resulted in health and energy benefits that outweighed the costs by almost twofold, largely due to a fall in household fuel costs and fewer sick days for adults and children.

New Research Recommended

Sauni et al. called for more research with a cluster-randomized controlled trial design that focuses on a wider range of validated outcome measures.

Slopen N, Fenelon S, Newman S, et al. Housing Assistance and Child Health: A Systematic Review. *Pediatrics*. 2018;141(6):e20172742.

Methodology

Slopen et al. identified 14 studies focused on children in the U.S. who received housing assistance by searching for studies published between 1990 and 2017 in the following databases: PubMed, Web of Science, PsycInfo, and PAIS. Three of these studies were longitudinal and the remaining 11 were cross-sectional. The authors focused on health outcomes relating to child mental and physical health, including violence and health behaviors, but excluding “proxies for health” (e.g., neighborhood conditions, number of school absences, cognitive outcomes, health care utilization, criminal behavior, etc.). The authors’ investigation emphasized large-scale federal housing programs operated by the U.S. Department of Housing and Urban Development. In order to meet the criteria for inclusion, studies had



to include evaluations of public housing, multifamily housing, or vouchers in relation to child health outcomes.

Level of Evidence/Study Quality

Two reviewers assessed the level of relevance and the methodological quality of each study returned by the preliminary search. Reviewers developed a scoring system based on the Agency for Healthcare Research and Quality's Methods Guide for Comparative Effectiveness Reviews¹⁴ and evaluated the rigor of each study on this scale.

Major Findings

Slopen et al. determined that the evidence on the relationship between child health and housing assistance is mixed. Approximately 40% of the studies they reviewed did not report any association between housing assistance and health outcomes. Within the literature the authors reviewed, reports of positive associations between housing assistance and child health were more common than negative associations. The authors also note that the factors they evaluated that are associated with receipt of aid from the U.S. Department of HUD may also be associated with negative health outcomes, aside from health itself, because housing assistance is not usually randomized.

Implementation

The authors noted that previous research has suggested that referring children to other resources that address social determinants of health at primary care visits is associated with receipt of services and resources to meet basic needs. They suggested that although the housing assistance programs they reviewed did not utilize this strategy, future implementation of housing assistance programs might benefit from practitioners embedding these services into pediatric visits.

ROI

The authors did not address any return on investment for the HUD programs they studied.

New Research Recommended

Slopen et al. expressed the need for novel strategies that address selection bias in observational studies investigating child health and housing assistance programs. Specifically, the authors identify three areas where more research is necessary: effects of housing assistance for specific types of child health outcomes; effects of housing assistance by child, family, or housing program; and investigation of latent or long-term impacts of housing assistance that may manifest later in life.

Thomson, H, Thomas S, Sellstrom E, Petticrew M. Housing Improvements for Health and associated socioeconomic outcomes. Cochrane Database of Systematic Reviews. 2013;2:CD008657.

Methodology

Authors Thomson et al. searched 27 academic and grey literature bibliographic databases for papers published between 1887 and 2012. In addition, the authors searched 12 Scandinavian grey literature and policy databases, as well as 23 relevant websites. These searches returned a total of 39 studies which reported quantitative and/or qualitative data and met the qualifications for inclusion in their review. These studies included: 5 randomized controlled trials, 10 non-experimental studies of



improvements in warmth, 12 non-experimental studies of rehousing and retrofitting, 3 non-experimental studies of basic improvements in housing in LMICs, and 3 non-experimental studies of rehousing from slums. The authors included studies from any region of the world, including industrialized and low- and middle-income countries. Four studies focused on U.S. populations.

The authors reviewed studies that focused on a range of health outcomes including: general health outcomes (e.g., self-reported health, longstanding illness), respiratory health (e.g., wheezing, asthma symptoms), mental health (e.g., self-reported anxiety and depression), and other health-related outcomes and behaviors (e.g., sleeping problems, limitations to mobility, smoking and drinking). The authors selected studies that focused on health and social impacts of housing interventions, where interventions were defined as “rehousing and any physical change to housing infrastructure.”

Level of Evidence/Study Quality

Two review authors evaluated the quality of the studies included in the review using the risk of bias tool and the Hamilton Assessment Tool (to assess the quality of non-experimental and uncontrolled research).¹⁵ This tool was developed by a group of systematic researchers in Hamilton, Canada to serve as a critical appraisal instrument for assessing risk in non-randomized studies. Thomson et al. used this tool to assess study quality as it was considered sensitive enough to evaluate quality across varying study designs.

Major Findings

Thomson et al. reported that those studies that evaluated warmth and energy efficiency housing improvements and interventions are most likely to report improvements in health. The authors report that evidence from the studies they reviewed suggests that appropriately sized, affordable-to-heat housing is associated with improved health and social relationships. Programs that deliver improvements across broad areas and do not target individual needs produce mixed results. However, impacts reported at an area level may not reflect potentially larger improvements for intervention recipients who might benefit most.

Implementation

The authors recognize that variation in intervention implementation has the potential to introduce bias or explain differing outcomes. For this reason, the authors assessed each study for “within-study heterogeneity,” evaluating how each intervention was implemented in addition to evaluating variation in the extent to which participants experienced improvements in housing condition.

ROI

Among the randomized controlled trials that the authors reviewed, two evaluated warmth improvements in New Zealand and found that the benefits achieved through housing improvements outweighed the costs of implementation.

Thomson et al. reported that another study evaluated the impact of housing improvements on child health and number of school days missed due to asthma, concluding that the cost benefits the National Health Service observed in response to the intervention outweighed the implementation costs.



New Research Recommended

Thomson et al. reported that the existing body of literature on warmth improvements is too heterogeneous to allow for comparison and synthesis. Research gaps exist with respect to impact timescale, housing improvements, and potential health outcomes. The authors called for more rigorous evaluation of intervention efficacy prior to widespread implementation of the interventions.

Weitzman M, Baten A, Rosenthal D, et al. Housing and Child Health. Current Problems in Pediatric and Adolescent Health Care. 2013;24(8):187-224.

Methodology

Authors Weitzman et al. did not conduct a systematic review of the literature, but rather conducted a broad survey of the current literature on housing and health, including recent interventions on lead exposure, indoor air quality, water quality, housing structure and design, other harmful household exposures not related to housing structures, and family structure and design. In each of these domains, the authors synthesized the most rigorous, recent literature and summarized the findings of the research. They examined longitudinal and cross-sectional studies of children in the U.S. and focused on the following health outcomes: cognitive and behavioral health, blood concentrations of lead, carbon monoxide poisoning, tobacco exposure, asthma, and other adverse health outcomes.

Level of Evidence/Study Quality

While the authors did not comment on the granular methods they used to select the studies they summarize, they did note that they aimed to include aspects of children's lives that significantly affect their health and development, but that are frequently omitted in conversations about healthy homes.

Major Findings

Weitzman et al. hold that housing and housing quality have huge ramifications on children's health through numerous pathways and that interventions aimed at improving housing lead to measurable improvements in child health.

Implementation

The authors commented on the implementation success of some previous interventions, such as policies to reduce the use of lead paint which have resulted in significantly less exposure in children. However, they also commented on problematic implementation observed in a multifaceted intervention associated with positive outcomes related to asthma symptoms, yet whose conclusions are limited because of the inclusion of multiple interventions which may have confounded results.

ROI

Weitzman et al. did not explicitly report returns on investment for the interventions they evaluate, but they did acknowledge that evidence suggests many of these interventions are cost-effective, including the following interventions: targeting building deficiencies (recognized as a cost-effective intervention by the HUD), reducing the levels of radon in the home through affordable test kits, and reducing energy costs which are associated with better health outcomes.



New Research Recommended

The authors called for more research to identify hazards and mechanisms in the home through which child health is impacted, both positively and negatively. They also expressed the need for more rigorous investigation into interventions that effectively ameliorate these negative effects on health. Specifically, Weitzman et al. suggested that more research is urgently needed on the health impacts of carbon monoxide exposure and the confounders of the relationship between tobacco smoke exposure and conduct disorder.

Woodhall-Melnik JR, Dunn JR. A systematic review of outcomes associated with participation in Housing First programs. *Housing Studies*. 2016;31(3):287-304.

Methodology

Woodhall-Melnik et al. conducted four searches using different keywords relating to housing and Housing First for literature published from 2000-2013 in the following electronic databases: Web of Science, PubMed, and Scholars' Portal. The authors focused on studies that conducted evaluations of housing retention in populations of people experiencing homelessness who also had psychiatric symptoms, addictions, or other concurrent disorders. They examined health outcomes including substance use, psychiatric symptoms, and quality of life, as well as outcomes not related to health, including service use and costs, housing retention, and other outcomes associated with Housing First programs. They included both randomized controlled trials as well as observational studies.

Level of Evidence/Study Quality

Woodhall-Melnik et al. relied on a study appraisal method developed by Thomson et al. which groups articles into five categories from very weak to strong.¹⁶ "Very weak" studies are typically cross-sectional and do not adjust for confounding variables while studies with evidence designated as "strong" are prospective, RCT studies with greater than 80% follow-up for more than six months with objective measurements of health outcomes.

Major Findings

Woodhall-Melnik et al. reported mixed results on whether Housing First impacts psychiatric symptoms or substance use. However, based on the evidence they reviewed, the Housing First model is associated with improved quality of life, with respect to family, finances, leisure, and perception of choice. Additionally, Housing First seems to be successful in reducing homelessness and increasing residential stability and housing retention among people typically classified as "hard to house."

Implementation

Woodhall-Melnik et al. observed that the implementation of Housing First programs varies widely, with respect to factors like the types of support provided and tenancy models. Housing First has become an umbrella term for a range of services provided, which may account for some of this variation. The authors commented on the need to arrive at a more standard definition and implementation practices, both to standardize research practice and to more effectively implement Housing First programs. The authors also commented on the fact that Housing First was initially developed to be implemented for individuals experiencing both homelessness and psychiatric symptoms at the same time. They



recommend that, if Housing First is to be implemented in the future, rigorous research must be conducted into how to address the needs of different target populations within their local context.

ROI

Woodhall-Melnik et al. conclude that, taken together, the studies they reviewed suggest that Housing First participants exhibit reduced participation in the criminal justice system. The authors found that Housing First participants show less utilization of emergency services and that participation in a Housing First program is associated with decreased substance use and treatment services.

In some studies, evidence suggests cost reductions are associated with decreased emergency department use, inpatient hospitalizations, and engagement with the criminal justice system, though the authors cautioned that these findings are not consistent across the literature they reviewed.

New Research Recommended

Woodhall-Melnik et al. called for more research that investigates outcomes of Housing First that are less well-understood, such as substance use and psychiatric symptoms. Future research needs to evaluate the longer-term outcomes of Housing First participants and engage in a more rigorous evaluation of outcomes for targeted sub-populations in a wider range of locations.



3.0 Education

3.1 Introduction

Greater educational attainment is closely associated with health, a relationship that has been demonstrated in the literature across multiple disciplines. The mediating pathways that facilitate this connection are much less clear. Although a number of pathways have been proposed^{17,18} (including ones involving health literacy and behaviors, employment opportunities, and social and psychological factors, as well as pathways of reverse causality where health affects education), the degree of causality and the details of these proposed mechanisms remains unclear.

What is clear is that increasing the amount of education individuals receive is associated with a range of benefits, many of them health-related (e.g., fewer functional limitations and serious health conditions).¹⁹ In addition, educational attainment has benefits in areas related to health indirectly (e.g., earning potential). These benefits become even more important when we consider the fact that the gradient in health outcomes by educational attainment has steepened in the U.S. over the last four decades.²⁰ This trend is causing a widening health gap between Americans with high and low levels of education, which translates to significant disparities in mortality rates. The most recent report from the National Center for Health Statistics concluded that people with at least some college education have a mortality rate less than half that of those without any college education.²¹

More research is needed in order to tease out the extent to which these relationships are causal or affected by other factors that are not captured in previous studies. However, a major problem arises in that randomization of educational interventions presents logistical and ethical challenges. Even when a degree of randomness is achieved in the experimental design, small sample sizes and limited follow-up place limitations on the findings. For these reasons, “natural experiments” that exploit changes in policy in place and time are the most frequently studied educational intervention; commonly studied policies of this type are “compulsory schooling laws,” which mandate a minimum level of educational attainment for children. Even so, the body of literature on educational interventions is relatively weak and narrow.

We present the most recent reviews on educational interventions (mostly focused on quantity, with one review investigating education/school environment quality) and their effects on health outcomes. The following section and subsequent table summarize our findings, and a more detailed summary of each review follows.

3.2 Summary

From the literature summarized below, we have drawn the following, high-level conclusions:

- Education is closely associated with improvements in specific health outcomes, but only for certain populations and timespans.
- The literature is mixed on whether education has a causal effect on health, although the following results are documented relatively consistently in the literature:
 - Educational reforms—compulsory schooling laws, in these specific studies—have robust effects on educational attainment and earning potential, but very little effect on health outcomes other than mortality;
 - Educational attainment is associated with improvement in a select range of health outcomes, but not others;



- Educational attainment differentially affects men and women and may have a significantly larger effect on men;
 - Educational interventions aimed at improving school quality may have the greatest potential to improve health and behavioral outcomes related to physical activity.
- Authors of the reviews we evaluated call for more research in the following areas:
 - Examination of a wider range of health outcomes with attention to the heterogeneity of the effects of education;
 - Evaluation of intervention components separately and in combination, and evaluation of intervention effects at a more granular level;
 - Greater reliance on and investigation of theory in the design and implementation of interventions;
 - More nuanced consideration of interactions between determinants of education and health, as well as interactions with other determinants of health;
 - Further exploration of mechanisms of pathways from education to health;
 - Exploration of effects of educational interventions at higher and lower levels of education;
 - Emphasis on quality of schooling rather than sole focus on years of schooling completed.



3.3 Tabular Summary of Reviews

Paper	Populations studied	Health outcomes of focus	Types of studies	More education/ higher-quality education	Major Findings	Return on Investment (ROI)
Bonnell C, Jamal F, Harden A, et al. Systematic review of the effects of schools and school environment interventions on health: evidence mapping and synthesis. Public Health Research. 2013;1(1):1-320.	School-aged children (4-18 years of age) who attended schools that underwent an environment intervention in the US and UK	Health (e.g. injuries and social anxiety), health behaviors (e.g. aggression and condom use), and health promotion outcomes (e.g. attitudes toward aggression)	Randomized controlled trial, quasi-experimental	Higher-quality education	There is potential to bring about positive health outcomes by improving the school environment, particularly for measures aimed at building community and increasing physical activity.	No report of cost effectiveness.
Cannon J, Kulburn M, Karoly L, et al. Investing Early: Taking Stock of Outcomes and Economic Returns from Early Childhood Programs. RAND Corporation. 2017.	Children ages 0-5 or parents of children ages 0-5 who received interventions	Behavior and emotion, cognitive achievement, child health	Majority RCT, some studies using quasi-experimental design	Both	Most early childhood programs improve at least one outcome for children.	When cost-benefit analyses have been performed, most programs appear to pay for themselves.
Galama T, Lleras-Muney A, van Kippersluis H. The Effect of Education on Health and Mortality: A Review of Experimental and Quasi-Experimental Evidence. NBER Working Paper. 2018. 126:1-21.	Studies published since 2005 that focus on causal effect of education	Mortality, smoking, obesity	RCT, twin difference design, quasi-experiment	Both	Education lowers mortality among men, but only for specific populations and timespans.	No evaluation of return on investment.
Hamad R, Elser H, Tran DC, et al. How and why studies disagree about the effects of education on health: A systematic review and meta-analysis of studies of compulsory schooling laws. Social Science and Medicine. 2018; 212:168-178.	Birth cohorts subject to compulsory schooling laws across 25 countries	25 health outcomes including: fertility, self-rated health, obesity, smoking, mortality, cognition, mental health, hypertension, physical activity, child health, and others	Quasi-experimental	More education	Education not shown to influence infant mortality, biomarkers, height, lung disease, and heart disease. Education worsens outcomes for cancer and alcohol. Education shown to improve health for remaining 17 outcomes.	Future research needed to evaluate potential cost benefits of the reduced risk of negative health outcomes this review identifies.

Paper	Populations studied	Health outcomes of focus	Types of studies	More education/ higher-quality education	Major Findings	Return on Investment (ROI)
Hendren N, Sprung-Keyser B. A Unified Welfare Analysis of Government Policies. National Science Foundation. July 2019.	U.S. residents who were the recipients of policy changes in the last half century	Marginal value of public funds (MVPF)	MVPF Framework	Both	MVPF is high for programs and policy changes related to investment in child education and health.	In early child education literature, some report on a favorable social benefit-cost ratio
Mazumder, B. The effects of education on health and mortality. Nordic Economic Policy Review. 2012:261-301.	Cohorts subject to compulsory schooling laws in the United States and Europe	Primary outcomes: mortality and hospitalization. Other outcomes include: health behaviors, BMI, illness, and others.	Cross-sectional (instrumental variables and regression discontinuity designs)	More education (Brief review of studies examining quality of education)	There is not enough clear evidence to draw a causal connection between education and health. U.S. studies do suggest some evidence of causality but more work is needed.	Increased quality of education may improve individuals' labor market capital in addition to health outcomes but more research is needed.

3.4 Review of Literature

Bonnell C, Jamal F, Harden A, et al. Systematic review of the effects of schools and school environment interventions on health: evidence mapping and synthesis. Public Health Research. 2013;1(1):1-320.

Methodology

Authors Bonnell et al. conducted a literature search of 16 bibliographic databases placing no restrictions on language or date of study. As part of a larger project, the authors compiled an “evidence and theory map” in order to synthesize evidence related to the health effects of school environment interventions. Of the references identified in the evidence and theory map, an in-depth synthesis was conducted for the specific research question relating to health outcome evaluations of the interventions under study. This synthesis resulted in 10 studies that evaluated the outcomes of interventions aiming to modify school environment and measure health outcomes. Six of these studies were randomized controlled trials and four were quasi-experimental studies that used prospective comparison group design. All of these studies were published between 1988 and 2010 and evaluated multicomponent interventions delivered in elementary and middle schools in the U.S. and elementary and secondary schools in England.

The interventions examined fell into the following categories: those targeted to both students and staff in an effort to develop stronger sense of community and reduce aggressive behavior, those that encouraged staff and students to promote an environment of healthy eating and physical activity, and those directed toward improving school playgrounds. For the purpose of this review, we characterized these interventions as those directed toward improving school quality.

Level of Evidence/Study Quality

The methodological quality of the 10 included studies was judged against seven quality criteria: impact of intervention was reported for all outcomes, allocation to the intervention and comparison conditions was random, allocation was non-randomized but involved matching or adjustment for confounders, study groups were equivalent at baseline, overall attrition was <30%, attrition rates differed by <10% between groups, and analysis accounted for cluster. These criteria were modified based on those used in EPPI-Centre health promotion reviews. Two authors independently evaluated whether each study met these criteria. The authors reported that the quality of studies they reviewed was “generally quite poor,” and did not attend to issues of attrition and adjustment for clustering.

Major Findings

With respect to the interventions targeted at community building, the authors reported that there is potential to bring about beneficial health outcomes by changing the school environment, particularly with respect to measures targeting violence and aggression. The authors determined that no interventions demonstrate any evidence of causing harm. The strongest study in this category of community building evaluated the Aban Aya Youth Project intervention and concluded that school environment change is associated with fewer significant health benefits than changes to curriculum only. However, Bonnell et al. found that the evidence base for this category of intervention suggests positive potential but does not provide conclusive evidence.



The evidence base for the effectiveness of interventions aimed at improving food and physical activity environments is somewhat stronger, and Bonnell et al. reported that there is some evidence of intervention benefits for health outcomes measuring physical activity but no intervention benefits for measures of healthy eating.

Bonnell et al. concluded that there is not strong enough evidence on the effects of interventions aimed at improving playgrounds in schools to draw any conclusions about the effectiveness of the interventions and whether they influence health outcomes.

Implementation

The authors evaluated all the process measures for the interventions they reviewed (if included in the reports) and found that five of these reports included process evaluations. They relied on a range of research methods, often using quantitative data collected by students and/or teachers. Most of the studies examined feasibility or fidelity, but did not place a strong emphasis on acceptability or evaluation of how the local context influenced the intervention process. Still, despite methodological variation preventing direct comparison of delivery and uptake between the various interventions, the process evaluations under review reported positive results with respect to feasibility, fidelity, reach, and acceptability of the interventions.

Return on Investment

None of the studies reviewed reported any evaluation of cost-effectiveness.

New Research Recommended

The authors identified significant gaps in the literature and called for future intervention studies that: address a wider range of environmental factors in schools, examine multiple outcomes, rely more heavily on theory, include evaluations of cost-effectiveness and process evaluations, and investigate intervention components separately and in combination. Additionally, the authors identify the need for multilevel studies that rely more heavily on theory, examine more exposures, outcomes, and health effects in different school models, and evaluate interventions on a more granular level than the school, as well as future qualitative research into broader areas of health and school setting. They suggested that future reviews should engage in more focused investigation of the school environment and targeted interventions.

Cannon J, Kulburn M, Karoly L, et al. Investing Early: Taking Stock of Outcomes and Economic Returns from Early Childhood Programs. RAND Corporation. 2017.

Methodology

Cannon et al. conducted a literature search by first identifying a list of known early childhood programs and then conducting a systematic literature search in databases for program impact evaluations. The authors reviewed abstracts to identify evaluations that measured at least one child outcome and targeted a child aged 0-5, a parent or caregiver of a child aged 0-5, or a pregnant mother or parent expecting a child. The authors only included studies that used an RCT or strong quasi-experimental design, and those that were published between 1972 and 2015. This process resulted in a set of 269 publications that met the criteria for review.



The interventions examined fell into four broad approaches: early care and education, home visiting, parent education, and transfers. The majority of the programs evaluated were early care and education interventions (e.g. preschool), and this is the category of intervention we focused on for the purpose of our review. The primary outcomes that were examined fell into the following domains: behavior and emotion, cognitive achievement, and child health. However, some outcomes also fell into the following categories: developmental delay, child welfare, crime, educational attainment, employment and earnings in adulthood, family formation in adulthood, and composite measures.

Level of Evidence/Study Quality

The authors did not qualify the level of evidence of the studies they reviewed, however, they established a set of criteria for maximal scientific rigor: only randomized controlled trials and rigorous quasi-experimental studies were reviewed. These criteria are based on previous RAND syntheses, and consist of the following: “the program was referred to by a specific name that distinguished it from other programs or generic approaches; the program targeted at least one of the following: any child from birth up to age 5 (or prior to kindergarten entry), any parent or caregiver of a child from birth to age 5, or any pregnant mother or parent expecting a child; and the intervention did not focus on a special-needs population such as children with autism spectrum disorders or children who are deaf or blind.”

Major Findings

The authors found that most early childhood programs improve at least one outcome for children. Across all the programs the authors reviewed, they found that 102 programs (89%) improve at least one child outcome, and nearly a third of all the outcomes evaluated are positive. Outcomes in the domains of cognitive achievement and developmental delay are more likely to improve than outcomes in other domains, yet in the domain of child health, 27% of the outcomes were found to be positive (where 72% of outcomes were found to be null and 1% unfavorable).

Implementation

The authors commented on the fact that most of the program evaluations they reviewed reported on whether or not an early childhood program was successful, but not on which features are responsible for the relevant outcomes. Additionally, the authors observed variation in program implementation, and though some of the studies they evaluated are of high fidelity, Cannon et al. cautioned that many of these were also conducted on a small scale and implementation strategies and outcomes may change when scaled up.

Return on Investment

Nineteen of the programs Cannon et al. evaluated included economic analyses. Taking these analyses together, the authors concluded that early childhood programs can produce economic benefits that outweigh the costs, but that the estimates that have been made of economic return are not definitive. Having stated these caveats, the authors reported that the benefit-cost ratios they reviewed fell within the range of \$2 to \$4 for every \$1 invested. Some higher ratios were found in low-cost programs that ameliorated costly outcomes, such as those relating to high health care costs.



The authors also reported that the benefits of early childhood investments often unfold over time and may take years to decades before cumulative monetary benefits match or exceed the upfront costs.

New Research Recommended

Cannon et al. called for more research that involves longer-term follow-up to investigate if the impacts and outcomes of early childhood programs are sustained. Especially given that many returns on investment are not meaningfully measurable until the cohorts under study reach adulthood and beyond, Cannon et al. emphasized the importance of this longitudinal approach.

The authors also called for more research that investigates the relationship between early childhood outcomes and outcomes later in adulthood. Furthermore, although less of a focus in our review, Cannon et al. made the case that early childhood programs can also have significant effects on the parents of these children and that future research should adopt a two-generation perspective when evaluating early childhood programs.

Cannon et al. also identified the need for comparative effectiveness studies and program evaluations that collect outcomes across a range of domains.

Galama T, Lleras-Muney A, van Kippersluis H. The Effect of Education on Health and Mortality: A Review of Experimental and Quasi-Experimental Evidence. NBER Working Paper. 2018. 126:1-21.

Methodology

Galama et al. conducted a literature search for studies that investigate the links between education and health. They included studies that were published after 2005, focus on the causal effect of education on all-cause mortality/smoking/obesity, and relied on one of the following study designs: RCT, twin difference design, or quasi-experiment to assess the causal effect of education on health. Because of the lack of RCTs and twin-studies meeting these criteria, the authors focused primarily on quasi-experiments, reviewing 5 randomized controlled trials (4 from the U.S.), 7 twin studies (2 from the U.S.), and 35 quasi-experiments (9 from the U.S.).

The authors focus on obesity and smoking as their primary outcomes, both of which are universally considered to be indicators of bad health and are the first and second leading causes of preventable death in the United States. The authors also use mortality as an easily measurable outcome.

Level of Evidence/Study Quality

The authors do not explicitly comment on their methods for evaluating the level of evidence of the studies included. They attend to the limitations of each study they include in their review and are transparent about where evidence is weak (e.g. the causal link between education and obesity) and where it is much stronger (e.g. randomized controlled trials that strongly support the causal effect of early childhood education on health).

Major Findings

The authors drew several major conclusions from the interventions they investigated. They found that interventions that increase schooling are linked to some improved health behaviors and that across all the interventions they reviewed, earnings, social skills, and connections are improved by the intervention. They also found that the Perry Preschool Program is linked to improvements in non-



cognitive skills and motivation, which, in turn provide benefits such as higher income, greater social connections, and stable marriages, which may in part explain improved health behaviors in later life.

Across the twin studies they reviewed, the authors reported that education is associated with lower mortality and reduced smoking. The results from these studies suggest that a year of education may reduce mortality by 4-5%.

Broadly, the authors concluded that education lowers mortality among men, but only for specific populations and timespans. Based on the evidence, education does not seem to show an effect on smoking, at least from a *causal* perspective, except for populations considered “disadvantaged,” or for people who experience a change in their peer groups in response to an educational intervention. Furthermore, the authors concluded that the education-obesity link is not well investigated in the literature. Across all studies with varying designs, education seems to affect men’s outcomes more strongly than women’s.

The authors commented on several problematic aspects with the implementation of these ECE programs: the Perry Preschool Program targeted African American children who would now be considered cognitively impaired; the ABC program drew from poor populations with low baseline IQs; and the ABC intervention incorporated a large health component, so it is difficult to tease apart health outcomes that stem from education and those that stem from other aspects of the intervention.

Implementation

No discussion of implementation challenges or facilitators.

Return on Investment

The authors did not evaluate the cost implications of the interventions they investigated. However, they did develop a model to help explain the investment and payoffs of education, where the optimal level of schooling occurs when the net marginal benefits of staying in school equal the net marginal costs.

New Research Recommended

The authors recommended that future research move toward better understanding the heterogeneity in the effects of education. Future research could benefit from compiling study results into large databases to increase population coverage while focusing the number of outcomes. The authors also recommended a more rigorous investigation of theoretical and experimental work, particularly, more research on the interactions between determinants of education and health.

Hamad R, Elser H, Tran DC, et al. How and why studies disagree about the effects of education on health: A systematic review and meta-analysis of studies of compulsory schooling laws. *Social Science and Medicine*. 2018; 212:168-178.

Methodology

Authors Hamad et al. conducted a search of electronic databases (Google Scholar and PubMed) and manually searched reference lists for English-language studies (published and unpublished) between 1990 and 2015 that investigated health outcomes in response to compulsory schooling laws (CSLs). They claim to be the most comprehensive review of compulsory schooling laws to date, identifying a total of 89 studies from 25 countries (mainly the U.K., U.S., Italy, Sweden, Denmark, France, Germany Netherlands, Austria, Norway, and Spain, among others); 18 of these studies were in the U.S.



Each manuscript was screened for relevance by three investigators. For each study included in the review, the authors documented the country where the research took place, the birth cohorts that were included, and the analytic methods used (ranging from ordinary least squares and Cox regression, to instrumental variables and regression discontinuity).

The studies examined over 25 different health outcomes, including: fertility, self-rated health, obesity, smoking, mortality, cognition, mental health, hypertension, physical activity, child health, nutrition, functional ability, alcohol use, birth weight health utilization, diabetes, lung disease, pregnancy-related, cancer, infant mortality, heart disease, biomarkers, sexual health, and others. The studies in the U.S. focused most heavily on outcomes of self-rated health, mortality, fertility, hypertension, functional ability, and health utilization.

Level of Evidence/Study Quality

The authors included all studies that met the following criteria: involving original data analysis, examining outcomes that are health-related, and using a primary predictor directly related to compulsory schooling laws. The authors did not make additional comments on the quality of the literature they reviewed.

Major Findings

Hamad et al. found that there is no evidence of an effect of education on five health outcomes: infant mortality, biomarkers, height, lung disease, and heart disease. For cancer and alcohol use specifically, increased education is associated with a negative effect on health outcomes. The evidence that Hamad et al. reviewed suggests that educational attainment has a positive effect on health for the remaining 17 outcomes.

The authors conducted a meta-analysis and found that educational attainment is associated with decreased mortality, decreased probability of being a current smoker, reduced risk of obesity, and reduced hypertension.

The authors addressed the heterogeneity of compulsory schooling law implementation. Given that their review spanned such wide range of countries, time periods, and geo-political contexts, Hamad et al. noted that the heterogeneity of CSL implementation means that findings in one specific country may not be generalizable in other countries and settings.

Implementation

No discussion of implementation challenges or facilitators.

Return on Investment

The authors did not report any returns on investment, but their meta-analysis shows that a year of education is associated with 20% reduced risk of obesity, and small reductions in risk of mortality, smoking, and hypertension. They did not report cost-savings in response to these reductions, but they addressed the need for future cost-benefit analyses to measure potential savings on these educational investments.

New Research Recommended

Hamad et al. noted that there was not sufficient evidence to conduct meta-analyses on other non-cardiovascular health outcomes, and they called for more research involving these less-studied



outcomes that are not directly related to cardiovascular disease. They suggested that future studies use similar measures and analytic methods used in the current body of work to allow for more meta-analyses. However, they suggested that future work might look at these outcomes from different angles to investigate other aspects of the health outcomes in question. Hamad et al. also suggested that future work should look at the mechanisms of the findings they reported and attempt to tease apart the pathways from education to health outcomes.

Hendren N, Sprung-Keyser B. A Unified Welfare Analysis of Government Policies. National Science Foundation. July 2019.

Methodology

Hendren and Sprung-Keyser analyzed 133 policy changes that occurred over the past half century in the U.S. and focused on those relating to social insurance, education and job training, taxes and cash transfers, and in-kind transfers. Then, for each policy under evaluation, the authors leveraged existing estimates of causality to approximate the benefit of a policy to its recipients, and the net cost including long-term effects to arrive at a calculation of the Marginal Value of Public Funds (MVPF), equal to “willingness to pay” divided by “net cost to the government.” This metric allows for comparison of policies’ total impact on social welfare.

Level of Evidence/Study Quality

The authors raised the concern that creating MVPFs using current literature relies on estimates of causality that may vary in quality. For this reason, the authors implemented a screening mechanism and drew on notable survey articles to arrive on the group of policies they eventually analyzed. The authors restricted their MVPF estimates such that they were based only on estimates of causality that came from randomized controlled trials, and found that their pattern of results did not change. When they similarly restricted their estimates to those from peer-reviewed publications, they also found that their basic results remained the same.

Major Findings

The authors reported that MVPFs are highest for the direct investments in health and education of low-income children. In their review, these policies included Medicaid expansions, childhood education spending, and expenditures on college. The Perry Preschool program was calculated to have an MVPF of 43.61 and the Abecedarian model an MVPF of 11.89. The authors found infinite MVPFs for increased spending on K-12 education and for specific college policies including admission to universities or provision of grants to low-income students (the authors use the term “infinite MVPF” to refer to any policy with a positive willingness to pay and a negative net cost).

Implementation

Hendren and Sprung-Keyser suggested that in the future, measures of MVPF can guide implementation decisions, where programs that have had historically high MVPFs might produce more benefits if they are expanded and invested in, while those with negative MVPFs should be seriously modified or cut altogether.



Return on Investment

The authors reported that most of the policies targeting children they reviewed do not face the “classic budgetary tradeoff” and tend to pay for themselves in the long run. The large, positive MVPFs for the policies they investigated suggest that these interventions represent some of the most worthwhile policies to invest in.

New Research Recommended

Hendren and Sprung-Keyser made several recommendations for future research. They suggested that MVPFs be calculated in other settings, including crime policy and tax enforcement, given that these areas significantly affect the government budget. Additionally, they suggested that future randomized controlled trials focus on a social welfare framework.

Mazumder, B. The effects of education on health and mortality. *Nordic Economic Policy Review*. 2012:261-301.

Methodology

Mazumder investigated studies that examined compulsory schooling laws as a means of evaluating how educational interventions affect health outcomes, reviewing a total of 10 studies, 2 of which are from the United States, and the remainder of which are from the United Kingdom, Sweden, France, Germany, Denmark, and the Netherlands. These studies were published between 2005 and 2012. Mazumder then examined other strategies to identify causal effects of education on health, surveying 9 additional studies that relied on twin comparisons, draft avoidance behavior in the U.S., and diffusion of health information to investigate how education might have a causal effect on health outcomes. These studies are extremely heterogeneous, and the health outcomes of focus span a range including: mortality, health behaviors, BMI and obesity, illness, hospitalizations and health care utilization, birth-related outcomes, and self-reported health status.

Mazumder also conducted a brief survey of literature and considered how school quality affects health and economic outcomes, reviewing three studies that examined the effects of desegregation as a proxy for improved school quality for Black children in the U.S. This group of studies was published between 1982 and 2011.

Level of Evidence/Study Quality

Based on methodological structure, rigor, and degree to which the authors controlled for other variables, Mazumder classified a group of studies as “most convincing” including: those that leveraged law changes and controlled for other potentially confounding variables that might affect long term health. Mazumder made no other formal comments about the study selection process or level of evidence.

Major Findings

An examination of the most rigorous studies on compulsory schooling laws led Mazumder to conclude that CSLs are strongly linked to improved education and earning, but have almost no effect on any health outcomes. A small subset of studies, including ones done in the U.S., are associated with slightly improved rates of mortality and beneficial effects on health outcomes like vision, hearing, and back pain, after implementation of compulsory schooling laws, but Mazumder suggested that these effects may have resulted through pathways unconnected to education.



Implementation

Mazumder made no comments on implementation effectiveness but noted the heterogeneity of implementation across compulsory schooling laws, desegregation efforts, and other “natural experiments” that have been studied to investigate the link between education and health.

Return on Investment

Mazumder concluded that most of the evidence reviewed is not strong enough draw conclusions about positive causal effects of education on health, let alone a return on investment. However, within the literature investigating how the quality of schooling affects health and economic potential, Mazumder reported that some researchers have suggested that class size and teacher quality may be key determinants of future labor market earning capacity, in addition to improved health outcomes and decreased per-pupil spending.

New Research Recommended

Mazumder identified a major limitation of using compulsory schooling laws to examine the effects of education, where these CSL studies may only be able to examine narrow effects on those who received the “intervention,” unable to examine broader population effects or effects at higher and lower levels of schooling. Mazumder touched upon other varying approaches (twin difference, military draft avoidance, response to health information), but called for future research to build on these approaches in an attempt to capture a wider range of effects.



4.0 Health Care Access

4.1 Introduction

The U.S. is the only developed country that does not provide universal health coverage. Even after the insurance coverage expansion of the Affordable Care Act (ACA), about 28 million Americans remain uninsured.²² Studies have consistently found that health insurance is significant predictor for health outcomes.²³

Under the ACA, Medicaid expansion was intended to be implemented across all states with a universal rollout, but in 2012, the Supreme Court ruled that expansion was optional, and only 29 states and the District of Columbia expanded in 2014, with 8 more expanding since then. This variation in expansion has created the opportunity to study the effect of Medicaid coverage on health outcomes, and a number of the studies we include below capitalize on differences in health outcomes between expansion and non-expansion states.

The literature we present below in tabular and summary form is only a small fraction of what has been published on health care access related to insurance coverage in the U.S. and how coverage, in turn, affects health outcomes. Our review of this literature does not aim to be comprehensive, but does aim to present a survey of the current understanding of how insurance coverage relates to health care outcomes, with particular attention to mortality as the primary health outcome of focus.

4.2 Summary

From the literature summarized below, we have drawn the following, high-level conclusions:

- Medicaid eligibility expansion is closely associated with reduced mortality for internal causes (e.g., cancer or cardiovascular events) as opposed to external (e.g., auto accidents);
- In addition to reducing overall mortality, Medicaid expansion may be associated with other outcomes that improve health over the long term, and may not be fully captured in the health outcomes of focus;
- Insurance expansion has the largest effect on reducing mortality for nonwhite children and adults, populations that have the greatest potential to benefit;
- Overall, increasing health insurance coverage is a cost-effective way to increase life-years;
- Authors of the literature we evaluate call for more research on the following questions:
 - Which diseases are the biggest contributors to overall mortality for those who are eligible for expanded coverage?
 - What causes of mortality see the biggest impact from expanded coverage?
 - What broader effects does expanded coverage have on health on a longer time scale?
 - They also call for future research on randomized data, though this may be difficult or impossible due to various significant challenges with RCTs relating to insurance expansion.



4.3 Tabular Summary of Reviews

Paper	Populations studied	Health outcomes of focus	Type(s) of study/studies	Major Findings	Return on Investment (ROI)
Brown DW, Kowalski AE, Lurie IZ. Long-Term Impacts of Childhood Medicaid Expansions on Outcomes in Adulthood. NBER Working Paper Series. 2019.	Children born from 1981-1984	Fertility, mortality	Observational	Greater Medicaid eligibility in childhood increases college enrollment, decreases fertility, and decreases mortality.	The federal government recovers 57¢ per \$1 invested in childhood Medicaid.
Clayton D. The Effect of Prescription Drug Coverage on Mortality: Evidence from Medicaid Implementation. Journal of Health Economics. 2019;63:100-113.	U.S. residents in states that underwent Medicaid expansion for prescription drugs from 1966-1975	Mortality	Observational	A \$1 increase in Medicaid drug expenditures per U.S. resident reduces internal mortality by 0.23%.	The cost per death averted for Medicaid drug program was \$49,600 while the cost per life-year saved was \$19,600. These measures suggest that Medicaid prescription drugs add life years cost-effectively
Goodman-Bacon A. Public Insurance and Mortality: Evidence from Medicaid Implementation. Journal of Political Economy. 2017;126(1)216-262.	Infants and children in the U.S. in the 1960s and 70s	Infant and child mortality	Observational	Among nonwhite children, Medicaid coverage was associated with a 20% reduction in mortality.	The authors estimate the cost per death averted to be \$1.83 million.
Miller S, Altekruze S, Johnson N, Wherry LR. Medicaid and Mortality: New Evidence from Linked Survey and Administrative Data. NBER Working Paper Series. 2019; No. 11,113: 1-36.	Near-elderly adults in states with and without Affordable Care Act Medicaid expansions	Mortality	Observational study (pre, post)	The authors find a 0.13% decline in annual mortality and 9.3% reduction over the sample mean associated with Medicaid expansion for near-elderly adults.	No formal ROI, but the authors do estimate that 15,600 deaths would have been averted by wider Medicaid expansion.



Paper	Populations studied	Health outcomes of focus	Type(s) of study/studies	Major Findings	Return on Investment (ROI)
Sommers BD, Baicker K, Epstein AM. Morality and Access to Care among Adults after State Medicaid Expansions. <i>New England Journal of Medicine</i> . 2012;367(11):1025-1034.	Adults between 20 and 64 who lived in New York, Maine, and Arizona at the time of Medicaid expansion	Mortality, insurance coverage, delayed care due to costs, self-reported health	Observational	Medicaid expansions were strongly associated with lower mortality, improved coverage, and better access to care and self-reported health.	Medicaid expansion was associated with lower rates of delayed care due to high cost of care.
Wherry LR, Meyer BD. Saving Teens: Using a Policy Discontinuity to Estimate the Effects of Medicaid Eligibility. <i>Journal of Human Resources</i> . 2016;51(3):556-588.	Cohorts born between 1980 and 1987 in the U.S.	Immediate and long-term mortality, doctor visits, and hospitalizations	Regression discontinuity and difference in difference	Medicaid expansion has a larger effect on black children than white children, and black children gained two times as much eligibility. Black children who gained eligibility experienced substantial mortality improvements later in life but this improvement was not observed among white recipients.	Medicaid paid an estimated \$1.62 million (1992 dollars) per life saved.
Woolhandler S, Himmelstein DU. The Relationship of Health Insurance and Mortality: Is Lack of Insurance Deadly? <i>Annals of Internal Medicine</i> . 2017;167(6):424-431.	Recipients of insurance expansions in the U.S. and other wealthy nations	All-cause mortality	Review of quasi-experimental studies and randomized controlled studies	The evidence reviewed supports the Institute of Medicine's hypothesis that health insurance saves lives and the authors report that the odds of dying among the insured versus the uninsured is 0.71 to 0.97.	No evaluation of ROI
Studies published related to the Oregon Health Insurance Experiment					
Baicker K, Allen HL, Wright BJ, Taubman SL, Finkelstein AN. The Effect of Medicaid on Dental Care of Poor Adults: Evidence from the Oregon Health Insurance Experiment. <i>Health Services Research</i> . 2018;53(4):2147-2164.	Participants in Oregon's 2008 Medicaid lottery	Utilization of dental care and dental outcomes	Randomized controlled design	Expansion of Medicaid to cover emergency dental care reduced the need for dental care, and increased use of the emergency department for dental issues by two-fold. Expansion did not affect uncovered dental care or OOP spending.	No evaluation of ROI

Paper	Populations studied	Health outcomes of focus	Type(s) of study/studies	Major Findings	Return on Investment (ROI)
Baicker K, Allen HL, Wright BJ, Finkelstein AN. The Effect of Medicaid on Medication Use Among Poor Adults: Evidence from Oregon. <i>Health Affairs</i> . 2017;36(12):2110-2114.	Participants in Oregon's 2008 Medicaid lottery	Use of prescription medications	Randomized controlled design	Medicaid expansion led to a significant increase in the use of prescription medications.	No evaluation of ROI, but the authors report that upstream investments in pharmacological management of chronic illness may reduce downstream illness and expensive procedures.
Baicker K, Allen HL, Wright BJ, Taubman SL, Finkelstein AN. The Effect of Medicaid on Management of Depression: Evidence From the Oregon Health Insurance Experiment. <i>The Milbank Quarterly</i> . 2018;96(1):29-56.	Participants in Oregon's 2008 Medicaid lottery	Health care utilization, depression outcomes	Randomized controlled design	Medicaid coverage reduces the rate at which depression goes undiagnosed by 50% and the rate of untreated depression by over 60%.	No evaluation of ROI
Taubman S, Allen HL, Wright BJ, Baicker K, Finkelstein AN. Medicaid Increases Emergency Department Use: Evidence from Oregon's Health Insurance Experiment. <i>Science</i> . 2014;343(6168):263-268.	Participants in Oregon's 2008 Medicaid lottery	Emergency department utilization	Randomized controlled design	Medicaid coverage increases overall utilization of ED services by 40% across a broad range of types of visits, conditions, and sub-groups.	Medicaid may increase annual spending in the emergency department by about \$120/covered individual.
Baicker K, Taubman SL, Allen HL, Bernstein M, Gruber JH, et al. The Oregon Experiment—Effects of Medicaid on Clinical Outcomes. <i>The New England Journal of Medicine</i> . 2013;368:1713-1722	Participants in Oregon's 2008 Medicaid lottery	Blood-pressure, cholesterol, glycated hemoglobin; screening for depression; medication inventories; self-reported diagnosis, health status, health care utilization, OOP spending	Randomized controlled design	Medicaid coverage had no significant effect on measured physical health for the first two years after coverage began, but it increased use of health care services, improved diabetes care, and reduced rates of depression and financial strain.	Medicaid coverage increased annual medical spending by about 35% compared to the control group.

4.4 Review of Literature

Brown DW, Kowalski AE, Lurie IZ. Long-Term Impacts of Childhood Medicaid Expansions on Outcomes in Adulthood. NBER Working Paper Series. 2019.

Methodology

Brown et al. used data from the Internal Revenue Service (IRS) to examine long-term effects of expansions to childhood Medicaid on outcomes in adulthood, including college enrollment, fertility, mortality, wage income, earned income tax credit receipts, and tax payments. The authors focused on cohorts born in the U.S. between 1981 and 1984, as children born during this time period were exposed to several expansions (Medicaid underwent significant expansion in the 1980s and for a second time in the 1990s), and their outcomes can be evaluated for each year of adulthood for ages 19-28. Inconsistencies in expansion resulted in considerable variation in insurance coverage even between children born in different months or states, creating a “natural experiment” for study.

Major Findings

Brown et al. found that Medicaid eligibility from birth to age 18 has significant impacts on adult health. In addition to outcomes relating to college enrollment, increased wage earnings, and earned income tax credits and receipts, the authors also reported statistically significant findings of reduced mortality and fertility for adults who were exposed to Medicaid eligibility in childhood. The authors reported that each additional year of childhood Medicaid eligibility saves 2.0 lives per 10,000 in aggregate. The authors also found that each additional year of Medicaid eligibility during childhood reduces the overall likelihood of having a child by age 19 by 0.35%.

Implementation

The authors commented on some aspects of the ACA Medicaid expansions on Medicaid eligibility and enrollment, given some of the nuances to the program and its rollout. They highlighted a particular stipulation of the rollout, where the ACA allowed hospitals to presume Medicaid eligibility for certain groups such that if patients “appear to have incomes low enough to qualify for Medicaid, hospitals may grant temporary Medicaid enrollment” and patients may immediately begin receiving health services. The authors hold that this ACA policy of not requiring individuals to first enroll in Medicaid before receiving care funded by Medicaid bolsters the idea that everyone eligible for the Medicaid program is covered, despite the fact that they are not all enrolled. For this reason, the authors considered those who are “conditionally covered” as well as those who are formally enrolled.

Return on Investment

The authors did not consider any formal economic evaluation of Medicaid expansion; however, they did estimate a “human cost” of the failure to expand in all 50 U.S. states at the same time, concluding that approximately 15,600 lives could have been saved had expansion been adopted universally.

New Research Recommended

The authors did not make recommendations for specific areas for future research except to suggest that, should better data become available, a more thorough exploration of cause of death may give more insight into the mortality data and present potential areas for reducing mortality and improving care access and quality.



Clayton D. The Effect of Prescription Drug Coverage on Morality: Evidence from Medicaid Implementation. Journal of Health Economics. 2019;63:100-113.

Methodology

Clayton investigated how Medicaid prescription drug spending affects mortality by using variation in rollout of Medicaid drug coverage. Clayton leveraged the changes in Medicaid groups that received prescription drug benefits from the years 1965 to 1975 among different states in the U.S. Clayton compiled data from the National Pharmaceutical Council's publication, "Pharmaceutical Benefits Under State Medical Assistance Programs" and these data were linked to mortality data from the National Vital Statistics System as well as state population data and county population data from the U.S. Census Bureau and the Surveillance, Epidemiology, and End Results program. Clayton evaluated the effect of Medicaid drug spending on mortality for regions with varying ratios of physicians per capita and varying ratios medical to surgical physicians. Clayton focused on mortality and cost-effectiveness as the primary outcomes of study and considered the effect of expanded coverage of prescription drugs to treat heart disease.

Major Findings

Overall, Clayton found that Medicaid expenditures and increased coverage of prescription drugs improved mortality from the years 1965-1975. She reported that increased Medicaid prescription drug coverage improves the health of the poor and contributed to the overall increase in life expectancy in the U.S. in the 1960s and subsequent decades.

In particular, Clayton found that increased prescription drug spending has almost no effect on mortality in counties with low physician per capita ratios; however, counties with the highest physician per capita ratios experience a significant decrease in mortality in response to increased spending. Clayton found that in regions with high physician-to-population ratios, increasing Medicaid spending by \$1/state resident is associated with an internal mortality decline of 0.27%. In areas with high medical to surgical physician ratios, this \$1 increase in spending is associated with a 0.30% mortality reduction.

Implementation

Clayton concluded that the incentives created to encourage states to provide Medicaid for all for welfare-receiving populations by 1970 in order to risk losing federal funding were extremely effective in persuading states to implement Medicaid. Title XIX was also highly effective in providing health care to welfare recipients as it uncapped the federal reimbursement limit for contributing to welfare programs.

Return on Investment

Clayton calculated the cost-effectiveness of Medicaid spending on prescription drugs and found that the cost per death averted for Medicaid drug program is \$49,600 while the cost per life-year saved is \$19,600. Based on these estimates, Clayton concluded that Medicaid spending on prescription drugs is a cost-effective way to add life years.

New Research Recommended

Clayton did not make many recommendations for future research, identifying the fact that her findings are some of the first to suggest a causal link between prescription drug coverage for the poor and mortality, therefore more research is necessary to investigate the broader effects on health that may



unfold on a longer time scale. Additionally, Clayton identified her research as establishing a critical link between coverage expansions and the provider landscape, which has important implications for health care reform and demands more investigation.

Goodman-Bacon A. Public Insurance and Mortality: Evidence from Medicaid Implementation. *Journal of Political Economy*. 2017;126(1)216-262.

Methodology

Goodman-Bacon examined the effect of Medicaid's introduction in 1965 on infant and child mortality in the U.S. in the 1960s and 70s. Goodman-Bacon used the federal mandate that U.S. states cover all cash welfare recipients to estimate the effect of this coverage on recipients. Goodman-Bacon then used a difference-in-difference framework to compare infant and child mortality rates before and after Medicaid implementation, and then, between higher- and lower-eligibility states. Using Multiple-Cause of Death Files, Goodman-Bacon constructed child and infant mortality rates from 1950-1979, examining all-cause mortality, as well as mortality rates for internal and external causes and for treatable and untreatable internal causes.

Major Findings

Goodman-Bacon found that, overall, Medicaid implementation increases insurance coverage and reduces child mortality. Mortality among nonwhite children fell by 20% during the time period of study, and this reduction corresponds to an overall reduction in nonwhite child mortality of 11%. Goodman-Bacon posits that the main pathway through which Medicaid implementation should produce an effect on mortality is via an increase in health care utilization.

Implementation

Goodman-Bacon commented on implementation, particularly the "statutory link between welfare *receipt* and Medicaid *eligibility*" that creates significant variation among states with institutional legacies of different welfare structures. Furthermore, Goodman-Bacon noted that the way in which Medicaid is implemented lends itself to study of a particular group: non-white children have the highest eligibility, so any effects of Medicaid implementation are most detectable in this group. Goodman-Bacon concluded that the way Medicaid was implemented in this era was well-targeted, as nonwhite children and infants were experiencing significantly higher levels of mortality, were the biggest utilizers of Medicaid, and experienced the largest benefit in mortality from increased coverage.

Furthermore, Goodman-Bacon explained that in terms of implementing Medicaid today, some channels, such as hospital switching (the sorting of recently insured mothers into better hospitals), continue to positively affect child and infant rates of survival. Goodman-Bacon suggested that while the estimates of reduced mortality for children eligible for Medicaid in the 60s and 70s might be smaller than those eligible today, improvements in technology likely mean that losing Medicaid coverage now might incur a larger cost in health than it would have half a century ago.

Return on Investment

Goodman-Bacon estimated the approximate cost of each death averted through Medicaid spending to be \$1.83 million, where infant deaths were less expensive to avoid than child deaths (an estimated \$160,000/infant death averted versus \$2.1 million/nonwhite child death averted). While these cost



estimates represent how spending relates to immediate life years gained and deaths avoided, they do not consider the benefits that may be incurred later in life as a result of Medicaid eligibility, including educational attainment and productivity.

New Research Recommended

No recommendation for future research.

Miller S, Altekruse S, Johnson N, Wherry LR. Medicaid and Mortality: New Evidence from Linked Survey and Administrative Data. NBER Working Paper Series. 2019; No. 11,113: 1-36.

Methodology

Miller et al. investigated the relationship between Medicaid coverage and mortality, drawing on two data sources: respondents from the 2008-2013 American Community Survey likely to benefit from the ACA Medicaid expansions, and the Census Numident file. Linking these data on Medicaid coverage and mortality, the authors observed the vital status of individuals during the year they responded to the ACS and the following year and examined changes in annual mortality in expansion states versus mortality in non-expansion states pre- and post-ACA Medicaid expansion.

Major Findings

Miller et al. reported that Medicaid expansion substantially reduces mortality rates among the population with the greatest potential to benefit: the near-elderly. Before ACA expansion, mortality rates between the groups in expansion and non-expansion states had relatively similar mortality rates. Following expansion, even in the first year, mortality rates declined significantly for respondents in expansion states, compared to their counterparts in non-expansion states.

Implementation

The authors did not explicitly address implementation except to mention the significant variability in expansion rollout in the 80s and 90s, which resulted in different groups with varying opportunities and eligibility for coverage.

Return on Investment

No formal evaluation of a return on investment.

New Research Recommended

The authors suggested that when better data become available, future researchers should aim to understand cause of death and which diseases are the biggest contributors to overall mortality for those who were Medicaid-eligible in childhood versus those who were not.

Sommers BD, Baicker K, Epstein AM. Morality and Access to Care among Adults after State Medicaid Expansions. New England Journal of Medicine. 2012;367(11):1025-1034.

Methodology

Sommers et al. examined the effects of Medicaid expansion in three states—New York, Maine, and Arizona—that underwent significant expansions since 2000, yet were surrounded by states that did not



expand. In their observational study, the authors focused on a study population of adults ages 20-64, whose health was examined for the five years before and after expansion. Their primary health outcome of interest was mortality, but they also investigated rates of insurance coverage, delayed care due to costs, and self-reported health. We included this study in our review but recognize its weak design.

Major Findings

Sommers et al. found that Medicaid expansion in New York, Maine, and Arizona was strongly associated with a decrease in mortality in the five-year follow-up period post-expansion, when compared to adjacent states that did not implement Medicaid expansion. They observed these mortality reductions to be greatest among adults between 35 and 64 years, racial minorities, and residents of poor counties. The authors estimated a 6.1% reduction in the relative risk of death when compared to non-expansion states, corresponding to 2,840 deaths prevented per year. They posit that a plausible causal chain for the reduced mortality may stem from eligibility expansions associated with a 25% increase in Medicaid coverage leading to 15% lower rates of uninsurance and an associated 21% reduction in delays in care, in turn leading to a 3% increase in self-reported health. However, Sommers et al. caveated that the magnitude of these changes may not fully explain the observed 6.1% reduction in mortality.

Implementation

No discussion of implementation.

Return on Investment

The authors conducted no formal evaluation of return on investment.

New Research Recommended

Sommers et al. recommended that future research focus on randomized data to build on their findings and continue to investigate how Medicaid expansion affects adult mortality, especially within beneficiary populations that are between 35 and 64 years of age, racial and ethnic minorities, and living in poorer areas.

Wherry LR, Meyer BD. Saving Teens: Using a Policy Discontinuity to Estimate the Effects of Medicaid Eligibility. *Journal of Human Resources*. 2016;51(3):556-588.

Methodology

Wherry and Meyer capitalized on the discontinuity of Medicaid coverage in the early 1980s, where several legislative changes designed to expand coverage meant that children born after September 30, 1983 would be subject to more generous eligibility criteria than those born even a month before, in September of 1983. The authors examined birth cohorts in the U.S. from 1980-1987 to model public eligibility and investigate health outcomes including short- and long-term mortality, doctor visits, and hospitalization.

Major Findings

Wherry and Miller found that greater Medicaid eligibility during childhood has a substantial effect on later life morality of black children at ages 15-18. The authors estimate that for this group born after September 30, 1983, internal mortality (death from “internal causes” according to the code on the



death certificate) declines by 13-20%. The authors also detected improvement in overall health of these children and that these gains in health were not reversed in early adult years. (Furthermore, because these improvements represented a decrease in internal mortality, which is much more amenable to improvements to health care, these observations suggest that eligibility expansions are likely a major contributing factor to mortality.) No improvement was observed for the mortality of white children who experienced expansions.

Implementation

No discussion of implementation.

Return on Investment

The authors calculated the approximate dollar amount the Medicaid program paid for each life saved to be \$1.62 million (in 1992 dollars). This figure is in line with previous cost estimates of spending per life saved and below what the Environmental Protection Agency reported as the “statistical value of life”: \$7.9 million (in 1996 dollars).

New Research Recommended

The authors noted that they were not able to identify the underlying causes for which health insurance had the biggest impact and suggested that future research attempt to answer this question. They recommended that as access to Medicaid claims data from this period grows, researchers may be able to more granularly examine the types of health care and services accessed by children who experienced eligibility expansion.

Woolhandler S, Himmelstein DU. The Relationship of Health Insurance and Mortality: Is Lack of Insurance Deadly? *Annals of Internal Medicine*. 2017;167(6):424-431.

Methodology

Using search terms relating to insurance, mortality, life expectancy, and death rates, the authors searched PubMed and Google scholar for English language articles published between 1984 and 2017, returning 11 articles that met the criteria for review. The authors focused on nonelderly adults because most prior research limits study to this demographic, which has been identified as likely to experience the greatest impact from changes in insurance coverage. They included primarily quasi-experimental and cohort studies, and one randomized controlled trial (the Oregon Health Insurance Experiment). Most of the studies were conducted in the United States, while some were conducted in other wealthy countries. The primary health outcome under study was mortality.

Major Findings

Overall, Woolhandler and Himmelstein concluded that health insurance reduces mortality. They explained that among several specific conditions, lack of coverage is associated with increased mortality and lower use of preventive care services. In particular, the authors reviewed the Oregon Health Insurance experiment, which is the only randomized controlled trial to measure the health outcomes of insurance, and seems to show an association between insurance and a decrease in mortality, but the wide confidence intervals suggest that the findings are not definitive.



Implementation

No discussion of implementation.

Return on Investment

No discussion of return on investment.

New Research Recommended

The authors stated that more evidence-based findings produced from randomized controlled trials would be helpful in future research. However, they also explained that future RCTs are unlikely, identifying the following reasons why the causal relationship between health insurance and mortality is so difficult to study: death from causes amenable to medical treatment is relatively rare among the nonelderly (the largest group of uninsured people); short-term studies do not capture the long-term health benefits of insurance; many people rotate in and out of insurance; random assignment of insurance is unethical; observational studies have to account for reverse causality; appropriate controls for baseline health in cohort studies is hard to account for; and quasi-experimental studies rely on a foundation of assumptions that cannot always be verified.

Studies published related to the Oregon Health Insurance Experiment

Baicker K, Allen HL, Wright BJ, Taubman SL, Finkelstein AN. The Effect of Medicaid on Dental Care of Poor Adults: Evidence from the Oregon Health Insurance Experiment. Health Services Research. 2018;53(4):2147-2164.

Baicker K, Allen HL, Wright BJ, Finkelstein AN. The Effect of Medicaid on Medication Use Among Poor Adults: Evidence from Oregon. Health Affairs. 2017;36(12):2110-2114.

Baicker K, Allen HL, Wright BJ, Taubman SL, Finkelstein AN. The Effect of Medicaid on Management of Depression: Evidence From the Oregon Health Insurance Experiment. The Milbank Quarterly. 2018;96(1):29-56.

Taubman S, Allen HL, Wright BJ, Baicker K, Finkelstein AN. Medicaid Increases Emergency Department Use: Evidence from Oregon's Health Insurance Experiment. Science. 2014;343(6168):263-268.

Baicker K, Taubman SL, Allen HL, Bernstein M, Gruber JH, et al. The Oregon Experiment—Effects of Medicaid on Clinical Outcomes. The New England Journal of Medicine. 2013;368:1713-1722

Methodology

The authors of these studies obtained data from thousands of adults who were randomly selected to be eligible to apply for Medicaid coverage in Oregon in 2008. The authors examined both primary and administrative data sources, relying on sources such as health care utilization and visit-level data, questionnaires, surveys, and in-person interviews questionnaires. The authors then used random assignment in the lottery to calculate the effect of Medicaid coverage.

Major Findings

The authors concluded that in the first year after the lottery, Medicaid coverage was associated with higher rates of health care utilization (significantly more outpatient visits, hospitalizations, prescription medications, and ED visits), lower probability of catastrophic spending and of having medical debts sent to a collection agency, and improved self-reported mental and physical health. The authors found that after two years, Medicaid coverage was associated with increased ED visits and that Medicaid did not



significantly influence physical health measures, though it was associated with increased health care utilization, improved rates of diabetes detection and management, and reduced rates of depression and financial strain.

Implementation

No discussion of implementation of the intervention.

Return on Investment

No formal discussion of ROI, but the authors noted that expanded Medicaid coverage during the years under study increased spending in the emergency department, although it dramatically reduced catastrophic expenditures for individuals who were covered in addition to reducing overall financial strain.

New Research Recommended

The authors acknowledged the limitations of their study (a relatively small sample size in one state, where most of the data collection took place in the large, urban area of greater Portland), and suggested that more research is needed to fully realize the effects of expanding Medicaid and whether further expansion will produce better health and outcomes.



5.0 Health Care Quality

5.1 Introduction

The gap between the quality of care that is *possible* in the U.S. and the care *received* by many is large. In the last two decades, there have been significant efforts to improve the quality of care patients receive in hospitals, and to work towards the National Academy of Medicine's stated goals that health care should be safe, effective, patient-centered, timely, efficient, and equitable—the markers of high-quality care.

In response to this increased attention on quality, a significant body of literature has emerged evaluating quality improvement efforts.²⁴ One means by which health care quality has improved is through the development of new and better treatments. Another is by improving the process of care so that those treatments are more available and timely. Our review captures both of these vectors of quality improvement.

Overall, several studies document that improvements in health care since the middle of the 20th century have been credited for a substantial proportion (40-50%) of longevity gains. We summarized much of that work in an earlier project report.^b Here, we supplement the summary provided in that report by focusing on a few key diseases.

Because the body of literature on quality of care interventions is vast and heterogeneous, we chose to restrict our review by focusing on mortality outcomes for specific conditions that are the leading causes of death in the United States. We have begun with cardiovascular disease and other cardiovascular conditions, and we may include other diseases like cancer and diabetes as we are able. Mortality rates for these conditions have been declining in the U.S. in recent decades, although annual declines for CVD mortality have slowed since 2011, and it now looks as though the American Heart Association goal of reducing CVD mortality by 20% by 2020 will not be reached.²⁵ Given these trends (likely related to quality improvement efforts) and that mortality is one of the most frequently used and easily measured outcomes, we surveyed papers that examined how cardiovascular mortality was affected by a process or treatment intervention in the quality of care.

While the papers we present below in tabular and summary form do not represent a comprehensive or systematic review, we do aim to present some of the most salient research on how improving the quality of care in hospitals has contributed to a decline in mortality of particular conditions.

5.2 Summary

After examining the body of recently published literature on how quality of care interventions are associated with trends in mortality for cardiovascular conditions, we draw several conclusions:

- With respect to cardiovascular mortality trends:
 - During the last two decades of the 20th century, about half of the decrease in CHD mortality was due to better management of risk factors, and half was due to improvements in and uptake of treatments.^{26–28}
 - Significant declines in AMI hospitalization and mortality between 1995-2014 may be due to improvements in treatment and adoption of new therapies during this period²⁹ in

^b Raphael K, Frakt A, Jha AK, Glied S. Social and Health-System Factors that Affect Health: What's Known and Knowable? A Review of Literature. Harvard University. 2019.



addition to better risk factor management and focus on quality for the entire U.S. population.³⁰

- The deceleration in the decrease of cardiovascular mortality after 2011 may be because the interventions, technologies, and population health improvements in the 20th century reached saturation in the population.³¹
- With respect to specific interventions:
 - For the population of smokers who are hospitalized with AMI, counseling and follow up may be both a life-saving and cost-effective intervention.³²
 - Improvements in cardiovascular rehabilitation have the potential to significantly improve mortality for cardiovascular conditions.³³
 - Revascularization for patients hospitalized with ischemic heart disease may result in improved clinical outcomes.³⁴
- With respect to future research, the authors of the literature reviewed call for:
 - Better research design, leveraging RCTs whenever possible, population-level data, and reliance on theory, for more policy translation;
 - Better economic evaluations leveraging the IMPACT tool to predict how investment can be maximized and closer investigation of how inpatient spending is related to other types of spending;
 - More research into disparities in cardiovascular care;
 - Emphasis on understanding the link between quality indicators and patient indicators;
 - Specifically, research into interventions regarding stress management, smoking cessation, assessment of blood-glucose levels in patients with diabetes, and better discharge summaries.



5.3 Tabular Summary of Reviews

Paper	Populations studied	Health outcomes of focus	Type(s) of study/studies	Major Findings	Return on Investment (ROI)
Quality of cardiovascular care					
Ford ES, Ajani UA, Croft JB, et al. Explaining the Decrease in U.S. Deaths from Coronary Disease, 1980-2000. New England Journal of Medicine. 2007;356:2388-98.	U.S. adults ages 25-84 between the years 1980 and 2000	Observed and expected numbers of deaths	Observational	About half of the decrease in mortality due to coronary heart disease between 1980 and 2000 is due to reductions in risk factors and the other half is due to medical treatment	No discussion of ROI
Guirguis-Blake JM, Evans CV, Senger CA, et al. Aspirin for the Primary Prevention of Cardiovascular Events: A Systematic Review for the U.S. Preventive Services Task Force. Annals of Internal Medicine. 2016;164(12):804-813.	Adults over 40 years of age in the United States, United Kingdom, Italy, and Japan	Nonfatal myocardial infarction, nonfatal stroke, all-cause cardiovascular mortality	Randomized controlled trial	The effect of aspirin in preventing cardiovascular events is very small and can be observed at doses of 100mg or less per day. Older adults seem to have a greater relative MI benefit	No discussion of ROI
Krumholz HM, Normand ST, Wang Y. Twenty-Year Trends in Outcomes for Older Adults With Acute Myocardial Infarction in the United States. JAMA Open. 2019. 2(3):e191938.	Medicare FFS beneficiaries over 65 in U.S. hospitals from 1995-2014	Thirty-day all-cause mortality, readmissions, recurrent AMI, in-hospital mortality, length of stay, rates of medical procedures	Cohort study	Improvements in short-term mortality and readmissions were observed for the Medicare beneficiaries with AMI, and these changes may be related to improvements in quality of care. An increase in in-hospital procedures and payments was also observed	Payments per hospitalization have increased, but overall costs have declined because the number of hospitalizations was greatly reduced
Krumholz HM, Nuti SV, Downing NS, Normand SLT, Wang Y. Mortality, hospitalizations, and expenditures for the Medicare population aged 65 years or older, 1999-2013. JAMA-J Am Med Assoc. 2015;314(4):355-65.	Medicare beneficiaries over 65 in the U.S. from 1999-2013	All-cause mortality, all-cause hospitalization, and hospitalization-associated outcomes	Serial cross-sectional analysis	Among the Medicare fee-for-service population over 65, mortality, hospitalizations, and spending/beneficiary decreased from 1999-2013. These general trends may be the result of increased attention to quality of care as well as better risk factor management.	Mean inflation-adjusted inpatient expenditures decreased from \$3,290 to \$2,801/beneficiary. Inflation-adjusted expenditure pre death increased from 1999 to 2009 and decreased in 2013.
Ladapo JA, Jaffer FA, Weinstein MC, Froelicher ES. Projected Cost-effectiveness of Smoking Cessation Interventions in Patients Hospitalized With Myocardial Infarction. Archives of Internal Medicine. 2011;171(1):39-45.	U.S. smokers hospitalized with AMI	Numbers of smokers, AMIs, deaths averted, health care/productivity costs, cost per quitter, cost per QALY	Monte Carlo model to project health/economic outcomes	Smoking cessation interventions involving counseling and supportive contact are associated with positive health outcomes and may be cost-effective	The authors report a cost-effectiveness evaluation of \$5050 per QALY and project other potentially cost-effective and cost-saving figures as a result of the intervention under study

Paper	Populations studied	Health outcomes of focus	Type(s) of study/studies	Major Findings	Return on Investment (ROI)
Mensah GA, Wei GS, Sorlie PD, et al. Decline in Cardiovascular Mortality: Possible Causes and Implications. <i>Circulation</i> . 2013;127(1):143-152.	U.S. residents at risk of CVD and CHD	Mortality trends	National surveys, regional surveillance efforts, cohort studies	CVD mortality has declined in the second half of the 20 th century (due to improvements in treatment and risk factor management), with a slight deceleration in the mortality decline in recent years.	No evaluation of return on investment
Moghei M, Oh P, Chessex C, Grace SL. Cardiac Rehabilitation Quality Improvement: A Narrative Review. <i>Journal of Cardiopulmonary Rehabilitation and Prevention</i> . 2019;39:226-234.	U.S. recipients of cardiac rehabilitation interventions	Quality indicators for cardiac rehabilitation programs	Range of research/publications on quality of care relating to cardiac rehabilitation	Cardiac rehabilitation was assessed to be high quality for the following indicators: promoting physical activity post-program, assessing blood pressure, and communicating with primary care.	No evaluation of return on investment
Sidney S, Quesenberry CP, Jaffe MG, et al. Recent Trends in Cardiovascular Mortality in the United States and Public Health Goals. <i>JAMA Cardiology</i> . 2016;1(5):594-599.	U.S. residents (trends examined from 2000 to 2014)	Annual rates of change and trend in the gap between heart disease and cancer mortality rates	Observational	Since 2011, there has been a deceleration in the decline in mortality of CVD, HD, and stroke	No evaluation of return on investment
Wijeysundera HC, Bennell MC, Qiu F, et al. Comparative-Effectiveness of Revascularization Versus Routine Medical Therapy for Stable Ischemic Heart Disease: A Population-Based Study. <i>Journal of General Internal Medicine</i> . 2014;29(7):1031-1039.	Stable patients with ischemic heart disease in Canada between 2008 and 2011	all, myocardial infarction, or repeat PCI/CABG as a result of revascularization	Observational cohort study	Patients with ischemic heart disease treated with revascularization when stable exhibited improved clinical outcomes	No evaluation of return on investment
Wijeysundera HC, Machado M, Farahati F, et al. Association of Temporal Trends in Risk Factors and Treatment Uptake With Coronary Heart Disease Mortality, 1994-2005. <i>JAMA</i> . 2010;303(18):1841-1847.	Residents of Ontario, Canada aged 25-84 from 1994-2005	Number of deaths prevented or delayed in 2005, secondary outcome measures included improvements in medical treatments and trends in risk factors	Prospective analytic study	From 1994-2005, CHD mortality decreased in Ontario, associated half with trends in risk factor improvement and half with improvements in medical treatments	No evaluation of return on investment

5.4 Review of Literature

Ford ES, Ajani UA, Croft JB, et al. Explaining the Decrease in U.S. Deaths from Coronary Disease, 1980-2000. New England Journal of Medicine. 2007;356:2388-98.

Methodology

Ford et al. examined trends in mortality due to coronary heart disease in U.S. adults age 25-84 between 1980 and 2000. They used the IMPACT Coronary Heart Disease Model, a statistical model validated in other studies, to combine major population risk factors (e.g. cigarette smoking, high blood pressure, elevated total cholesterol, obesity, diabetes, and physical inactivity) with typical medical and surgical treatments and calculate the number of deaths prevented or postponed by these various interventions. They collected data from the U.S. Census Bureau to determine U.S. population and age distribution during the period under study, and collected data on death, age, sex, and mortality rates from the National Vital Statistics System. The authors then stratified the deaths prevented or postponed by attributing them to reduction of risk factors and/or treatments.

Major Findings

The authors found that half of the reduction in CVD mortality during the time period under study could be attributed to improvements in treatments, and the other half to reductions in risk factors. They also found that the medical treatment most responsible for the mortality reduction (preventing or postponing approximately 159,330 deaths) was secondary prevention, followed by rehabilitation after myocardial infarction, initial treatments for AMI or angina, and treatments for heart failure and hypertension, statin therapy, and treatments for chronic angina. The authors estimated that 149,635 fewer deaths from coronary artery disease occurred due to changes in risk factors, the most influential being better control of cholesterol concentration and systolic blood pressure and decreased prevalence of smoking.

Implementation

No discussion of implementation.

Return on Investment

No discussion of return on investment.

New Research Recommended

The authors recommended further research into strategies for prevention coronary heart disease. They suggested that these future interventions be comprehensive and focus on increasing the coverage of treatments known to be effective and advancing population-based prevention through more effective management of risk factors.

Guirguis-Blake JM, Evans CV, Senger CA, et al. Aspirin for the Primary Prevention of Cardiovascular Events: A Systematic Review for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*. 2016;164(12):804-813.

Methodology

Guirguis-Blake et al. conducted a literature review by searching the following databases: MEDLINE, PubMed, Cochrane Central Register of Controlled Trials, and Cochrane Database of Systematic Reviews. Two reviewers independently screened 3,396 abstracts and 65 articles and found 11 randomized controlled trials that met the criteria for inclusion. The authors included RCTs that examined the primary prevention of CVD with oral aspirin and found that 20 articles met the following inclusion criteria: peer-reviewed, data-based papers written in English; published between 2000 and 2010; explicit statement that the aim of the intervention under study is to improve quality of care; inclusion of pre- and post-intervention data; based in adult general hospital. The interventions under study were classified as either technical or interpersonal. The study designs varied, but included pre/post design, phased, observations, time series cohort, or randomized controlled trial. These studies examined a wide range of outcomes, including: mortality, patient education, health care utilization, patient/family satisfaction, health behaviors, adherence to medical advice, process measures, and quality measures.

Level of Evidence/Study Quality

The authors used a system for assessing methodological rigor developed by The Grades of Recommendation, Assessment, Development and Evaluation Working Group (GRADE Working Group) and endorsed by the BMJ and Cochrane Collaboration.¹³ The GRADE system uses five criteria (limitation in design and implementation, indirectness of evidence, unexplained heterogeneity or inconsistency of results, imprecision of results, and high probability of publication bias) to classify the study's quality as high, moderate, low, or very low. Most of the studies included in the review were assigned GRADE classifications of moderate, low, or very low quality.

Major Findings

The authors concluded that the beneficial effect of aspirin for the primary prevention of CVD is very small, and the effect is observable at doses of 100mg or less. Aspirin reduced the risk for nonfatal myocardial infarction but not for nonfatal stroke and demonstrated little to no benefit for all-cause or cardiovascular mortality. The authors concluded that the effect of aspirin on myocardial infarction is more pronounced in older adults, but this finding was based on lower-quality evidence.

Implementation

The authors did not discuss implementation of this intervention but commented on the conflicting recommendations for use of aspirin to prevent cardiovascular events. In looking toward future implementation, they recommended tools to more effectively identify patients at high risk of CVD and to prevent overuse of aspirin for people who most likely will not benefit.

Return on Investment

No discussion of return on investment.



New Research Recommended

There is very little literature grounded in theoretical design or implementation, and the authors suggested that this lack of theoretical foundation may contribute to the minimal uptake of health research into policy implementation. For these reasons, the authors suggested that future work should use a stronger theoretical base. They also called for a more collaborative approach in future interventions as well as greater use of multidisciplinary teams, more consistent research design in terms of aspirin dose, duration of therapy, inclusion of baseline population characteristics, comorbid conditions, and baseline CVD risk at trial entry. Additionally, they recommended that more research would be possible if the duration of the trials was longer.

Krumholz HM, Normand ST, Wang Y. Twenty-Year Trends in Outcomes for Older Adults With Acute Myocardial Infarction in the United States. JAMA Open. 2019. 2(3):e191938.

Methodology

Authors Krumholz et al. examined trends in inpatient outcomes and costs of AMI the United States from 1995 through 2014. In their cohort study, they included data from a sample of 4,367,485 Medicare fee-for-service beneficiaries over the age of 65 during this twenty-year time period. The authors collected patient demographic information, dual eligibility status, and comorbidities. Their primary health outcomes of focus included thirty-day all-cause mortality (at patient, hospital, and county levels), 1-year recurrent AMI, in-hospital mortality, length of stay in hospital, payment per AMI at discharge, and rates of procedures relating to AMI (catheterization, percutaneous coronary intervention, coronary artery bypass graft surgery).

Major Findings

The authors found declines in AMI hospitalizations, 30-day mortality, and 30-day all-cause readmissions over the course of this 20-year time period (this decline in mortality was found across age, sex, race, and dual-eligibility groups). They also found increases in the 2014 Consumer Price Index-adjusted median Medicare inpatient payment (per beneficiary at the time of discharge) as well as an increase in inpatient catheterization. The authors suggested several possible reasons for the results they observed. First, Medicare has focused on improving quality of care for patients with AMI in the last two decades, including changes in treatment. Furthermore, in the 1990s, it was established that aspirin, beta-blockers, and rapid reperfusion therapy had the potential to improve outcomes for patients experiencing AMI in hospital. Improvements in these therapies and their widespread use in hospitals were largely the result of targeted campaigns led by CMS, the American College of Cardiology, the American Heart Association, and other national organizations.

Implementation

The authors explained that even though research has identified the potential of certain treatments to improve AMI outcomes, translation of this evidence into practice has been delayed. Collectively, many national organizations, local facilities, and clinicians on the ground spearheaded the effort to improve the quality of care for cardiovascular conditions in hospitals, but the authors noted the delay in adoption. In particular, areas of the country (deemed “health priority areas”) where mortality was highest experienced a slower rate of decline in AMI mortality concurrent with slower adoption of quality of care interventions.



Return on Investment

The authors reported that although payments per hospitalization have increased, overall costs declined over the two decades under study, largely because the number of hospitalizations was greatly reduced.

New Research Recommended

No recommendation for future research.

Krumholz HM, Nuti SV, Downing NS, Normand SLT, Wang Y. Mortality, hospitalizations, and expenditures for the Medicare population aged 65 years or older, 1999-2013. JAMA-J Am Med Assoc. 2015;314(4):355-65.

Methodology

Krumholz et al. analyzed cross sections of Medicare beneficiaries over age 65 (a total of 68,374,904 beneficiaries) between 1999 and 2013 in order to track trends in health and health care during a decade in which many changes in health care technology and delivery were occurring. The authors used Medicare denominator and inpatient files to focus on their primary outcomes: all-cause mortality (for all Medicare beneficiaries) and all-cause hospitalization and hospitalization-associated outcomes (fee-for-service beneficiaries only). The authors also gave attention to variation by geography and demographic group as well as intensity of care at the end of life.

Major Findings

The authors found that among their population of Medicare beneficiaries over the age of 65, all-cause mortality, hospitalizations, and expenditures per beneficiary decreased significantly from 1999 to 2013, in addition to improvements in outcomes during and after hospitalization and decreases in hospitalizations in the final 6 months of life. Krumholz et al. suggest five possible explanations for these trends: national efforts to improve the quality of care, including the Health Care Quality Improvement Initiative launched by CMS in 1992; an increase in healthy behaviors and risk factor management; changes in exposures over the life course; access to improved technology; and changing make-up of people enrolled in fee-for-service giving the appearance of a healthier population under study.

Implementation

No discussion of implementation.

Return on Investment

While the authors did not formally report a return on investment, they did conduct a cost evaluation and reported on expenditure trends during the time period they evaluated. Krumholz et al. found that from 1999 through 2013, the annual CPI-adjusted mean Medicare inpatient expenditure per beneficiary decreased from \$3,290 to \$2,801.

New Research Recommended

The authors suggested that additional research is needed to investigate all expenditures to understand how inpatient spending is related to other types of spending, with special attention to post-acute care. They also suggested that future research should use both clinical data and administrative claims data to provide more detail than what can be gleaned from medical records alone. Still, the authors claimed



that for the purposes of investigating their outcomes of focus, administrative data provide the necessary information to effectively conduct analysis.

Ladapo JA, Jaffer FA, Weinstein MC, Froelicher ES. Projected Cost-effectiveness of Smoking Cessation Interventions in Patients Hospitalized With Myocardial Infarction. Archives of Internal Medicine. 2011;171(1):39-45.

Methodology

Ladapo et al. used data from a meta-analysis of RCTs of smoking cessation interventions on populations of U.S. smokers hospitalized with acute myocardial infarction. Using a Monte Carlo cost-effectiveness model, the authors compared two primary options for smokers who were hospitalized with AMI: typical care (often a smoking cessation consultation and printed materials providing general information), or smoking cessation counseling with follow-up after discharge. The data on mortality and nonfatal AMIs were obtained largely from the late 1970s and 1990s. The authors evaluated the following health and cost-related outcomes: number of smokers, AMIs, deaths averted, health care and productivity costs, cost per quitter, and cost per QALY.

Major Findings

The authors concluded that smoking cessation counseling coupled with supportive follow-up after discharge is effective in saving both lives and money invested by reducing the incidence of smoking and its downstream negative health and social consequences. Ladapo et al. projected that implementing this intervention among smokers hospitalized in 2010 would produce 50,230 quitters and prevent 1,380 nonfatal AMIs and 7,860 deaths.

Implementation

No discussion of implementation.

Return on Investment

The authors reported significant cost-effectiveness and cost-saving estimates as a result of the smoking cessation intervention. The authors estimated that implementing this intervention for a cohort of smokers hospitalized in 2010 for AMI would cost \$27.3 million in nurse wages. When looking forward on a 10-year period, Ladapo et al. estimated it would save \$22.1 million in prevented hospitalizations, increase health care costs by \$166.4 million (largely as a result of increased average lifespan), decrease losses in productivity due to early death by \$1.99 billion, increase nonmedical spending by \$928 million, and result in “net positive value to society of \$894 million.” This translates to a cost-effectiveness estimate of \$5,050 per QALY. Furthermore, they reported that compared to several other interventions for AMI, smoking cessation with supportive contact is relatively inexpensive and compares very positively with beta-blocker use after AMI, medication for hypertension, statin use, and left ventricular assist devices. Ladapo et al. hold that their cost-effectiveness ratio is easily classified as a high-value intervention.

New Research Recommended

The authors suggested that, given their findings and the potential of smoking cessation counseling with follow-up to be a cost-effective, life-saving strategy for smokers admitted with AMI, policymakers and



researchers should investigate the inclusion of continued supportive contact with this population after discharge as a quality measure.

Mensah GA, Wei GS, Sorlie PD, et al. Decline in Cardiovascular Mortality: Possible Causes and Implications. *Circulation*. 2013;127(1):143-152.

Methodology

The authors reviewed the recent literature on the decline in cardiovascular mortality, surveying research that attempted understand the reasons behind the decline of the past several decades and the deceleration in mortality decline of the past several years. The authors did not outline their methodology, as this publication serves to contextualize the landscape of understanding around cardiovascular mortality, and to invite input to inform a follow-up conference where the NHLBI will develop a research agenda for CHD and CVD. They reported on studies that used a variety of methods including national surveys, regional surveillance efforts, and cohort studies.

Major Findings

The authors presented a broad picture of the knowledge on trends relating to cardiovascular mortality, explaining that during the second half of the 20th century, cardiovascular mortality declined dramatically in the U.S. due nearly equally to better risk factor management and advances in treatment, interventions that, in combination, significantly increased life expectancy. Mensah et al. caveated these observed improvements with the more recent finding that the decline in CHD mortality rate is decelerating.

Implementation

The authors identified several ways in which research might be more effectively translated into practice, including a more focused effort to apply implementation science to actual implementation practice. In order to effectively implement research findings, the authors suggested a coordinated national surveillance system to measure CVD mortality data on a more granular level, expanding the research base through a range of methods and through rigorous application of implementation science.

Return on Investment

No evaluation of return on investment.

New Research Recommended

The authors concluded that only a small percentage of clinical guidelines to treat cardiovascular disease are founded on high-quality evidence, and they hold that there is an urgent need for further research. They recommended that randomized controlled trials be conducted whenever possible, yet they also advocated for other types of research to broaden the field, including: population-based cohort studies, observational studies from clinical studies, research to generate “practice-based evidence”, and precision medicine. They also suggested work and research toward understanding and alleviating the disparities observed in cardiovascular health and health care.



Moghei M, Oh P, Chessex C, Grace SL. Cardiac Rehabilitation Quality Improvement: A Narrative Review. Journal of Cardiopulmonary Rehabilitation and Prevention. 2019;39:226-234.

Methodology

Authors Moghei et al. conducted a narrative literature review of quality indicators for cardiac rehabilitation programs in the U.S., Australia, England, Canada, Europe, and Japan. The authors identified key informants from the International Council of Cardiovascular Prevention and Rehabilitation in order to identify quality indicators for cardiac rehabilitation (CR) programs in their respective countries. The authors then conducted a literature search for CR indicators and other research on quality improvement in CR programs by searching PubMed, Scopus, and Cochrane Library databases, as well as searching for other related articles. The authors mined data from the Canadian Cardiac Rehabilitation Registry for quality indicators and searched for research on quality improvement strategies and how they might be used in the context of cardiac rehabilitation programs. The authors only included studies that had been published in English and were peer-reviewed, but they included studies of all designs.

Major Findings

After reviewing the literature, the authors concluded that there is not a wealth of knowledge surrounding cardiovascular rehabilitation quality. They recommended several quality improvement initiatives, based on previous findings of other studies, but hold that these potential interventions require testing in order to determine whether quality can be improved in those domains by the interventions in question.

Implementation

The authors made several recommendations for future implementation and improvement of CR programs, including: regular quarterly feedback reports to participating CR programs to let them know how their interventions are translating to outcomes, reminder systems and decision support to notify program staff and monitor support, and advocacy initiatives targeted toward attracting funding to support CR services. The authors suggested that these tactics for improved quality will result in more effective intervention implementation.

Return on Investment

No discussion of return on investment.

New Research Recommended

Having reviewed the literature and the current set of quality improvement measures used to assess CR, the authors made four recommendations for where quality improvement is most necessary and where future research and practice should focus. These include: stress management training for CR participants, smoking cessation, recommended components included in discharge summaries, and assessment of blood glucose levels in patients with diabetes. The authors also pointed out that more evidence is needed to understand the link between the quality indicators and patient outcomes, given that CR has been shown to be effective, but there are significant gaps in the literature between the recommended CR care and the actual care delivered.



Sidney S, Quesenberry CP, Jaffe MG, et al. Recent Trends in Cardiovascular Mortality in the United States and Public Health Goals. JAMA Cardiology. 2016;1(5):594-599.

Methodology

Sidney et al. used the Centers for Disease Control and Prevention Wide-Ranging Online Data for Epidemiologic Research data system in order to detect changes in mortality rates for some of the leading causes of death in the United States: cardiovascular disease, heart disease, stroke, and cancer from 2000 to 2011 and from 2011 to 2014. These data were examined and stratified by race/ethnicity. The authors focused primarily on comparing the gap between heart disease and cancer mortality rates.

Major Findings

The authors found that the rate at which mortality was declining for cardiovascular disease, heart disease, and stroke slowed significantly after 2011 and this deceleration was observed in all genders and race/ethnicity groups.

Implementation

The authors did not evaluate the implementation of the interventions under study. However, they speculate that part of the slowdown could have been because interventions implemented in the early part of the 21st century contributed to a significant initial decline in cardiovascular mortality, but that as implementation of the interventions, technologies, and population health improvements reached saturation market saturation, the decline may have slowed in response.

Return on Investment

No evaluation of return on investment.

New Research Recommended

The authors suggested future research into innovative efforts targeted at reducing mortality of cardiovascular disease and improvements in population-level prevention of cardiovascular disease.

Wijeysundera HC, Bennell MC, Qiu F, et al. Comparative-Effectiveness of Revascularization Versus Routine Medical Therapy for Stable Ischemic Heart Disease: A Population-Based Study. Journal of General Internal Medicine. 2014;29(7):1031-1039.

Methodology

The authors used data from the Cardiac Care Network of Ontario, Canada (a group of 18 hospitals that provide cardiac services) and linked them to population-based administrative databases. Their cohort included patients with an index angiogram indicating stable IHD between October 2008 and September 2011, and divided their cohort into two groups: those with an initial medical strategy and those with an initial revascularization strategy. They used these data to investigate all-cause mortality as a primary outcome, and hospitalization for nonfatal myocardial infarction and repeat revascularization as secondary outcomes.



Major Findings

Overall, the authors found that in their population of stable IHD patients who have received coronary angiography, revascularization resulted in improved risk-adjusted outcomes when compared to patients who underwent medical therapy. These results differ from what previous RCTs have found and the authors offer several potential explanations for their findings. First, they addressed the fact that their study was observational, although they attempted to control for this through risk-adjustment. They also suggested these differences may have originated from differences in populations of study, where RCT populations are more restricted. Finally, they concluded that for the results of RCTs to be effectively translated into practice, optimal quality of care must be provided, and this may not be the case for both revascularized and medical patients. Indeed, the authors suggested that revascularization may simply be a marker of higher quality care.

Implementation

While the authors did not evaluate the implementation of the intervention under study, they propose suggestions for research and practice moving forward. They speculated that they may have observed the differences in their study because medical therapy patients receive a lower quality of care than revascularization patients, and that this potential disparity demands attention in all future treatment decisions.

Return on Investment

No discussion of return on investment.

New Research Recommended

The authors suggested that their finding may be due to under-treatment of medical therapy patients and that this potential gap in quality of care should be the focus of future research and interventions targeted at optimizing medical practice and treatment. Furthermore, they emphasized that their results contrast with the findings of previous RCTs that found that medical therapy produced better outcomes than revascularization in patients with stable IHD; the authors hold that more research is necessary to explain the difference they observed.

Wijeysundera HC, Machado M, Farahati F, et al. Association of Temporal Trends in Risk Factors and Treatment Uptake With Coronary Heart Disease Mortality, 1994-2005. JAMA. 2010;303(18):1841-1847.

Methodology

Authors Wijeysundera et al. conducted a prospective analytic study of the population in Ontario, Canada between the ages of 25 and 84 years between 1994 and 2005. The authors used an updated version of the IMPACT model, which accounts for factors relating to treatment, risk factors (smoking diabetes, systolic blood pressure, cholesterol, exercise, and obesity), and population size, in order to estimate the reduction in mortality associated with these various factors. Their primary outcome of focus was deaths prevented or delayed in 2005, and their secondary outcomes included improvements in medical treatments and trends in risk factors.



Major Findings

The authors found that between 1994 and 2005 mortality for their Ontario study population decreased by 35%, equating to approximately 7,585 fewer deaths in 2005. 43% of this decrease was associated with improvements in treatment (primarily improvements in treating AMI, chronic stable artery disease, and heart failure) and 48% of the decrease was associated with better management of risk factors (primarily from reductions in cholesterol and blood pressure). Additionally, Wijeyesundera et al. noted that these positive trends were counterbalanced by simultaneous trends of increasing incidence in obesity and diabetes.

Implementation

No discussion of implementation.

Return on Investment

No discussion of return on investment.

New Research Recommended

The authors recommended using IMPACT to predict where investments can be maximized and how improvements can be optimized to have the largest uptake in treatment for a given population (specifically, the authors recommend this approach for research in low- and middle-income countries).

Additionally, the authors recommended collection of more population-level data on risk factors and incorporation of these data into future studies.



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