Financing prevention: opportunities for economic analysis across the translational research cycle

D. Max Crowley, PhD, Damon Jones, PhD

¹Pennsylvania State University,
University Park, PA, USA

Correspondence to: D Crowley
MaxCrowley@gmail.com

Cite this as: *TBM* 2016;6:145–152
doi: 10.1007/s13142-015-0354-8

Abstract

Prevention advocates often make the case that preventive intervention not only improves public health and welfare but also can save public resources. Increasingly, evidence-based policy efforts considering prevention are focusing on how programs can save taxpayer resources from reduced burden on health, criminal justice, and social service systems. Evidence of prevention's return has begun to draw substantial investments from the public and private sector. Yet, translating prevention effectiveness into economic impact requires specific economic analyses to be employed across the stages of translational research. This work discusses the role of economic analysis in prevention science and presents key translational research opportunities to meet growing demand for estimates of prevention's economic and fiscal impact.

Keywords

Benefit cost, Pay for Success, Economic evaluation, Shadow prices

Changing economic realities have raised prevention's profile among policy makers and practitioners [1–3]. Prevention efforts that target behavioral development are taking an increasingly prominent role in strategic initiatives to improve public health [4]. Early studies of prevention's economic impact highlight opportunities to reduce strain on social service systems and engage in strategic workforce development across the economy [5–7]. Now, researchers seek to understand how preventive interventions perform in the real world as well as quantify “what it takes” to carry out effective prevention efforts [3, 8]. Yet, researchers have struggled to translate these evaluations' estimates into actionable policy [9–12]. Ultimately, what it takes often refers to the availability of the “right” resources, at the right time, delivered in the right place—although what is right is often largely unknown [13, 14]. Within this paper, we consider the behavioral research opportunities to grow the science of investing in human development. First, we review changing policy and economic contexts that are stoking demand for economic estimates of prevention. Then, we present key translational research opportunities to meet this demand. Along the way, we highlight the vital role

Implications

Researchers: Economic analyses have a place across all stages of translational research and offer opportunities to increase the relevance and utility of prevention science.

Practitioners: Limited resources can be leveraged to make greater impacts by considering not only evidence of program effectiveness but also of an intervention's economic impact.

Policy makers: An increasing number of prevention strategies provide opportunities to not only improve public health but also save public resources—leading toward more efficient and accountable government.

economic analyses can play across the stages of translational research (Table 1).

TRANSLATIONAL RESEARCH ON THE ECONOMIC IMPACT OF PREVENTION

During a time of shrinking budgets, policy analysts have witnessed a growing demand to move beyond effectiveness evaluations in order to ascertain the economic impact of prevention efforts [3, 15]. In response, researchers are undertaking increasingly sophisticated analyses to develop robust, fine-grained economic estimates that can be used to guide public and private investment in prevention [16, 17]. This demand stems from multiple factors, with prominent drivers including growing (1) evidence-based policy initiatives, (2) interest in performance-based financing, and (3) the newly empowered US Preventive Services Task Force.

Evidence-based policy initiatives—A major area stoking demand for economic estimates of prevention's impact is growing from evidence-based policy efforts proliferating in the wake of the economic downturn [1, 18]. One of the most well-known of these is the *Results First Initiative* supported by the Pew and Macarthur Foundations. This initiative installs an evidence-based policy making approach, developed by the Washington State Institute for Public Policy

Table 1 | Translational research stages

Type	Type 0 translation (T0)	Type 1 translation (T1)	Type 2 translation (T2)
Definition	The fundamental process of translating findings and discoveries from social and biomedical sciences into research with human subjects	Moving from bench to bedside. Translation of applied theory to methods and program development	Moving from bedside to practice and involves translation of program development to implementation
Type	Type 3 (translation) [T3]	Type 4 translation [T4]	Type 5 translation [T5]
Definition	Determining whether efficacy and effectiveness trial outcomes can be replicated under real-world settings	Wide-scale implementation, adoption, and institutionalization of new guidelines, practices, and policies	Translation to global communities. Involves fundamental, universal change in attitudes, policies, and social systems

(WSIPP), to support legislative efforts to invest in prevention [17]. This approach conducts meta-analyses of the existing behavioral literature to populate a projection model—which, in turn, forecasts program impacts on state budgets [12, 19]. This includes estimated savings to the criminal justice, health care, and social service systems as well as increased state revenue from greater employment.

In Washington state, such strategic public investment allowed the state legislature to avoid construction of new prison facilities [20, 21]. This model’s proliferation into new states has already led legislatures to reallocate millions of dollars to evidence-based behavioral prevention programs [22]. Yet, this model is completely reliant on the existing literature to accurately depict programs’ costs and benefits. Specifically, to make such calculations, this approach relies on estimates of programs’ costs and benefits being available. As a result, when legislators use this approach to make budgetary decisions, a program that has yet to conduct any economic analyses can appear to be a risky investment relative to those that already demonstrate public savings. This policy making approach is indicative of a growing mentality in state and local governments of the need to make decisions based not only on the promise of well-intended services but also on evidence of their cost effectiveness [23, 24].

Pay for Success financing—A second area also growing demand for robust estimates of prevention’s economic impact can be seen in a new form of performance-based contracting known as Pay for Success financing [25]. Pay for Success financing is a contracting approach that aligns incentives for government, private investors, and nonprofit service providers [26]. In this arrangement, private investors pay for preventive interventions known to avert future public costs. A prearranged level of public cost aversion is determined during this contracting period, and an independent evaluator assesses whether these benefits actually occurred [27]. If achieved, investors receive their initial outlay in addition to a small return on their investment from government. Specifically, this contracting structure generally aims to reduce the need for remedial programs (e.g., juvenile detention, special education, emergency care) by building an agreement between government, investors, and a nonprofit prevention service provider [28].

This contract development is facilitated by an intermediary that helps multiple parties negotiate terms. During this process, a valuation advisor provides support on program delivery. An independent evaluator conducts an assessment to determine if the level of expected cost aversion was actually achieved in order to support investor payback [16].

Demand for these sorts of arrangements are so great that Bank of America Meryl Lynch was able to raise over \$13 million from private investors in less than 60 days to provide a preventive intervention to newly released juvenile offenders in Massachusetts [29]. In that bond, the goal was to reduce recidivism by 40 %. If this occurs, then investors will receive a 12.5 % return on their investment and Massachusetts will avoid over \$22 million in incarceration costs [28]. These agreements rely on the availability of high-quality economic analyses of programs’ public costs and benefits to structure such a deal. Unfortunately, many evidence-based programs are being passed over for interventions with less evidence because the latter have successfully linked program effects to economic returns [30].

US Preventive Services Task Force—A third area increasing demand for robust understanding of the value and burden of preventive interventions is the US Preventive Services Task Force (USPSTF). The USPSTF is a panel of 16 volunteer health professionals supported by the Agency for Health Research and Quality [31]. The USPSTF has been reviewing and grading preventive services for over 20 years. But, it was during the drafting and passage of the Affordable Care Act (ACA)—when prevention advocates wanted to increase coverage of effective preventive services—that it garnered national attention. To determine what prevention strategies would be considered effective and covered under ACA, legislators wrote into the law that any prevention service graded as an A or B by the USPSTF must be covered by Medicaid, Medicare, and any plan offered in the state insurance exchanges [32, 33]. It is important to note that low grades can result in insurers not being mandated to cover certain services, but the direct capacity to deny care is not part of the USPSTF’s purview.

The USPSTF is particularly relevant because its main aim is not to simply identify effective programs. Instead, the USPSTF is charged with weighing a

preventive service's potential burden and benefits to participants. In this manner, the USPSTF calculates a net benefit to determine final letter grades [34]. This net benefit is not monetized but instead employs an evaluation protocol that determines the magnitude (e.g., substantial, moderate, small, zero/negative) and certainty of the net benefit (e.g., high, moderate, low). Such evaluations require understanding the costs to participants and their impact. Unfortunately, many of the behavioral programs reviewed are not graded since they lack this crucial cost information.

TRANSLATIONAL RESEARCH OPPORTUNITIES FOR ESTIMATING ECONOMIC AND FISCAL IMPACT

Combined with persistently strained public budgets, the growing importance of evidence-based policy, performance-based contracting, and the USPSTF has greatly peaked policy makers' interest in preventive strategies that can reduce public costs without increased spending. While a growing number of evidence-based preventive interventions are available, the potential economic and fiscal impacts of these programs and policies are largely unknown [10, 35]. In particular, very few have successfully quantified their benefits in terms budget makers can use to make spending decisions (e.g., government-wide and agency-level budgetary impact) [15, 36].

Having this information is crucial to translating prevention programs and policies for use by government, nonprofits, and the private sector [24, 37]. This work—to define the economic impact of prevention applies across translational research stages—and can provide essential information for prevention planning. Table 1 highlights the five stages of translational research. These include (T0) the process of translating social and biomedical science into research with human subjects; (T1) translating applied theory to methods and program development; (T2) translation of program development to implementation; (T3) determining the degree research trial findings that can be applied to real-world settings; (T4) wide-scale implementation, adoption, and institutionalization of new guidelines, practices, and policies; (T5) translational to global communities leading to universal change in attitudes, policies, and social systems (see Fishbein et al. 2015 in this issue). This work to define the economic impact of prevention applies across translational research stages and can provide essential information for prevention planning. The following three categories as depicted in Fig. 1 outline approaches for defining economic impact: (1) shadow price development, (2) economic evaluation, and (3) financial projection. Each category is described in detail, followed by specific strategies and research activities therein (Fig. 1).

Shadow price development

In order to evaluate economic impact, researchers require credible estimates of the social value of an

intervention's effectiveness [38, 39]. When programs operate in efficient markets, their value can be estimated from changes in market prices and quantities. For instance, the cost of materials and labor for building a road can be directly estimated from local labor and materials markets [40]. In contrast, many prevention programs have no market within which to directly ascertain their outcomes' economic value (e.g., no explicit social-emotional health market). In such cases, a proxy of this economic value must be estimated. This proxy is known as a "shadow price" [39, 41]. Shadow prices are the probabilistic economic worth of an outcome based upon its relationship to other monetizable variables [40]. Such prices can be estimated by statistically linking program impact on nonmonetizable outcomes (e.g., achievement, behavioral problems) to monetizable outcomes in the participant's future (e.g., morbidity and lost productivity) [39].

This approach can be especially useful to researchers that are unable to follow participants over decades but wish to estimate the economic value of their work [10]. Unfortunately, few available shadow prices are applicable to behavioral prevention [9, 42]. Additionally, the estimates that are available generally cannot be assessed until early adulthood (e.g., graduation, employment). This makes it difficult for researchers studying early intervention to evaluate economic impact without extensive and costly longitudinal follow-up. The process of developing shadow prices includes a number of potentially fruitful translational research activities. Work within this category highlights the role economic analyses can play in type 0 and type 1 translation research efforts. In particular, this etiologic work can support translation of basic science discoveries to research with human subjects as well as moving from applied theory to intervention development.

Economic modeling of early risk—The first opportunity surrounding shadow price development is the process of linking early risk and protective factors to downstream economic impacts. Such work may be the most straightforward for researchers to integrate into etiologic studies of human development, where longitudinal efforts follow a cohort across time [43, 44]. These analyses entail statistical and econometric modeling of the relationship between an earlier risk or protective factor with outcomes of economic interest [45, 46]. Specifically, when downstream outcomes represent a monetizable sum, the relationship between early risk and future costs may be modeled. For instance, the lifetime increase in tax revenue from graduation is estimated to be around \$127,000 a graduate. Such estimates have a number of uses, including priority setting for greater research inquiry [10, 38]. Efforts to model "nonacademic skills" impact in adulthood are one example of the growing body of evidence indicating that skills such as emotion regulation, social competence, and grit can be linked to economic value [47–49].

Behavioral target identification—Building on models that elucidate the relationship between early risk and protective factors and downstream outcomes are

Fig. 1 | Translational research opportunities on the economic and fiscal impact of prevention

efforts to build causal models that elucidate the mechanism between potential behavioral targets and future costs [48, 50, 51]. Such models employ methods of design and statistical control to draw out specific behavioral syndromes that can be targeted to increase functioning and reduce economic burden [52]. One example is the use of experimental trials to understand how changes in specific outcomes impact distal economic costs (e.g., juvenile recidivism) [12, 28]. An important characteristic of many behavioral targets is the recognition of the multifinality of many early skills—where a specific behavioral phenotype early in life may be related to multiple domains in adulthood—in turn impacting multiple areas of the economy [35, 53].

Data-driven program planning—With the identification of behavioral targets, researchers then have the ability to strategically develop programs that seek to maximize program effectiveness and economic impact [54, 55]. Specifically, program optimization can occur around combining intervention strategies for different behavioral targets [56]. In turn, these strategies can be packaged within a prevention curriculum or policy. Optimization can include developing the most cost-efficient prevention strategy by combining different types of interventions together to maximize impact and savings [57–59].

Economic evaluation

While research around developing shadow prices can inform creation of new prevention strategies, many preventive interventions already exist that would benefit from a greater understanding of the programs' economic impact. Such efforts include (1) cost and cost-effectiveness analyses, (2) cost savings analyses, and (3) benefit-cost analyses. Work within this category highlights economic analyses that can be undertaken as part of type 2 and type 3 translational research efforts. Specifically, efforts to move interventions from bedside to general practice can be supported by evidence of cost effectiveness and return on investment. Further, understanding how a program will operate in real-world settings can be greatly facilitated by careful attention to intervention cost and downstream benefits.

Cost and cost-effectiveness analyses—To begin understanding the economic impact of programs, researchers can evaluate the costs and cost effectiveness of preventive strategies. Cost analyses provide a first step for understanding the resource needs to implement a program or policy [60, 61]. This includes identifying all intervention activities that consume resources, estimating the quantity of resources required to support those activities and then estimating those program costs with market estimates of the price of those resources [14, 62].

$$\text{Prevention Cost} = \sum \{ (Q_{\text{Resource A}} \times P_{\text{Resource A}}) + (Q_{\text{Resource B}} \times P_{\text{Resource B}}) + \dots \}$$

where Q is the quantity of resource x and P is the quantity of resource x . The quality of a cost analysis can in part be evaluated based on whether the cost estimate includes all the resources needed to successfully replicate program effects.

Once accurate cost estimates have been developed, existing or new effectiveness estimates may be used to calculate the incremental cost effectiveness of achieving different program effects [61, 63]. Specifically, this is the cost to achieve an individual program outcome (i.e., cost to prevent an emergency department (ED)

admission, new drug abuser, a year of lost life). An ICER is the incremental cost-effectiveness ratio that considers this quotient of the difference between and intervention and alternative prevention strategy's cost and effect.

$$ICER = \frac{Cost_i - Cost_c}{Effect_i - Effect_c}$$

where i is the intervention of interest and c is the comparator prevention strategy. ICERs that consider the same outcome can be used to compare the same

program and assist in decision making when considering responses to specific problems. These analyses can be useful for planning and resource allocation decisions. Importantly, they answer common questions posed by policy makers and budget writers [22, 64]. Further, by undertaking these analyses, researchers can provide decision makers with accurate estimates as opposed to back-of-the-envelope analyses that may consider only tangible resources but neglect crucial personnel, volunteer, and in-kind resources [65]. Both cost and cost-effectiveness analyses have limitations in their utility for informing decision makers. In particular, cost analyses do not consider program effectiveness. While a program may have a relatively low cost, compared to other programs, deciding whether it makes a good investment cannot be determined without understanding program impact [66]. Further, cost-effectiveness analyses are also limited by their tendency to focus on only a single outcome of interest [8]. As previously discussed, prevention strategies that intervene in early risk will often impact multiple domains of functioning (e.g., health, criminal justice, education, and labor outcomes) [5, 7].

Cost savings—To overcome many of these weaknesses, researchers can also consider the use of cost savings and benefit-cost analyses. Both not only utilize estimates from the cost analysis but also monetize program impact [42, 67]. For instance, a program that reduces the number of bed days for juvenile offenders or the cost of emergency services can often apply a monetary value to those intervention effects [68]. Such value can be estimated in multiple ways. Fiscal estimates will consider the value to public budgets (e.g., criminal justice or Medicaid system cost aversion) [69]. Financial estimates will often consider the savings to individuals or private entities (patients, hospitals) [70, 71]. Economic estimates will consider the interventions net value to society. A societal estimate will often use willingness-to-pay estimates to prevent certain outcomes for valuation (e.g., the willingness to pay to prevent an assault or drunk driving) [72].

Cost savings analyses tend to monetize the benefits of one or a few program outcomes [15]. These analyses employ fiscal and financial estimates of program savings (e.g., Medicaid savings from home visiting) [73]. Such estimates are of particular interest to government agencies and private payers. Cost saving analyses can be limited in their ability to draw comparisons between programs if the same outcomes and valuation methodology are not applied in all considered analyses [39]. For instance, estimates would not be comparable if one cost savings analysis valued the reduction in ED visits from intervention A with a public payer perspective while another analysis valued a reduction in ED visit from intervention B based on an insurer perspective. In this sense, cost savings analyses offer useful estimates for translational research efforts that seek to inform a specific payer but do not require consideration of all outcomes using the same methodology.

Benefit-cost analyses—Full benefit-cost analyses offer an alternative analytic approach that monetizes program outcomes and avoids many of the comparability

concerns surrounding cost savings analyses [10]. Specifically, benefit-cost analyses require valuing all significant outcomes from a societal perspective. In practice, the economic value is generally estimated based on society's willingness to pay for preventing the outcome. Revealed preference research is often used to consider the value of preventing different crimes [74]. Jury damage awards can be a proxy for the value of lost life or functioning [75].

Benefit-cost analyses also have limitations. When the outcomes identified are problematic to monetize, complete benefit-cost analyses may be difficult [67]. Further, some researchers and decision makers are hesitant to place a monetary value on certain outcomes (e.g., loss of life, health states) [76]. In cases of the former, cost savings analyses may be the logical alternative. In cases of the latter, cost-effectiveness analyses that consider utility adjustments may be more appropriate (e.g., quality-adjusted life years) [77].

Financial projection

Taking preventive intervention to scale requires at least a basic understanding of resource needs [78]. Increasingly, potential program adopters are demanding greater detail around not only program costs but also the expected benefits and return on investment from financing a prevention effort [27, 68, 79]. Such requests necessitate the use of projection models to estimate multiple financing scenarios for taking programs to scale. These strategies are already being employed as part of policy analysis within the *Results First* initiative as well as within social financing efforts (e.g., Pay for Success) [17, 28]. Researchers have the opportunity to embrace such projection efforts. Doing so can help demonstrate the utility of economic evaluation estimates and support translation efforts of preventive interventions. Three types of financial modeling promise to be particularly fertile for researchers. These include (1) infrastructure cost optimization, (2) fiscal models of intervention impact, and (3) performance-driven financing. Efforts to make financial projections of impactful interventions are a form of type 4 translational research that supports wide-scale implementation, adoption, and institutionalization of new guidelines, practices, and policies.

Infrastructure cost optimization—A particularly fruitful area of applied research in this category concerns modeling current prevention costs. Building on cost analyses of preventive interventions, financial projection models can be used to explore how cost will change based on local infrastructure and capacity [8, 14]. Such estimates seek to consider local capacity and recognize nonlinearities surrounding the costs of intervention scale-up (e.g., nursing shortages, local volunteer availability, participant travel distance, etc.). These models can be particularly useful for planning purposes and can facilitate more efficient resource allocation. For instance, intervention activities that support implementation fidelity can be balanced against spending on recruitment [80–82]. Such models can be

particularly useful for standardized prevention strategies that have identified core components of the model, which should not be changed [83].

Researchers can use cost optimization models to assess local infrastructure variation for a specific service area and consider existing capacity to adopt and implement the target intervention [84]. This includes programmatic knowledge and personnel availability as well as other key factors such as buy-in, expected turnover rates, as well as availability of volunteer or in-kind resources [60, 85]. Based on these assessments, estimation of resource needs for preadoption activities can be conducted (e.g., training, information sessions) [14]. In particular, variability in infrastructure can be compensated during the preadoption allowing for efficiencies that may not be possible once implementation begins (e.g., group vs. individual training and web-based vs. on-site communication) [86, 87].

Fiscal models of intervention impact—Efforts to create fiscal models of intervention impact have been increasingly refined over the last three decades often within policy analysis efforts. Contemporary models generally use local market prices to project benefits (e.g., state bed day, Medicaid, teacher costs). Projection estimates also recognize the uncertainty in estimates and model uncertainty using stochastic procedures (e.g., bootstrapping, Monte Carlo, agent-based models). Rarely reported in the academic literature, these analyses are often internal or published in reports [15, 88]. These analyses can vary in quality and comprehensiveness. Most are one-time analyses that are commissioned by a legislative committee or executive agency. As described earlier, the Washington State Institute of Public Policy for many years has represented a unique research enterprise that sought to provide an ongoing analysis frequently updated with current literature and estimates [22]. This model has now been incorporated into multiple state legislatures and is generally recognized as a leader in fiscal modeling of prevention efforts [19, 89]. Because the model relies almost solely on the published literature for program cost estimates, not surprisingly the WSIPP approach sometimes garners criticism for not including information in fiscal models that may be unpublished. It is our opinion that such key translational information goes unpublished because program evaluators struggle to find an outlet or focus their time on more traditional findings. Publication of such estimates will not only inform prevention efforts in states using the WSIPP model but would also allow states not using the model to better consider the potential value of prevention.

Performance-driven financing—Over the last few years, we have seen an exponential rise in interest surrounding performance-driven financing models that link funding to intervention impact in increasingly nuanced ways [25, 78]. While contingent funding for meeting service targets are relatively common, the increased interest in social impact bonds and Pay for Success financing has highlighted the opportunities of prevention to link financing to program outcomes [84]. Specifically, much of the excitement is related to

the opportunity to link intervention financing to cost aversion from successful programs effects [90]. While cost saving analyses are employed to assess whether programs have successfully achieved intervention targets that will trigger performance payments, projection models are heavily relied upon for program selection, contract negotiation, and implementation planning [27]. These often come in the form of feasibility studies that take existing estimates from effectiveness and economic analyses to make projections of local implementation scenarios [91]. These projections are generally on a scale that none of the programs have previously reached.

Unique from more traditional fiscal projections, these efforts require models that consider cost aversion to specific public agencies in order to ascertain the actual beneficiary [92]. The level of precision required of these estimates is substantially greater than is often demanded in other settings. Small errors can mean the difference in multimillion dollar performance payments in high-profile contexts [93]. There is broad recognition of not only the need for better estimates to support such financing schemes, but there are also opportunities for methodological innovation in modeling estimate uncertainty [30].

LOOKING FORWARD

As prevention science continues to mature, the efficient allocation of scarce public resources is increasingly important. Just as prevention scientists have transitioned from a focus on efficacy to effectiveness, prevention research and policy will be strengthened with greater focus on economic impact. Undoubtedly, this work will require multidisciplinary teams that include specialists in economic analysis. Teams undertaking such analyses, in conjunction with better cost estimation and benefit valuation, have the opportunity to demonstrate that prevention efforts can not only be effective in the real world but also can be efficient public investments. Such translational research endeavors will not only save money but also allow practitioners to reach more people, improve more lives, and make a greater impact.

Acknowledgments: This work was supported by a grant from the National Institute of Drug Abuse (R13 DA036339).

Compliance with ethical standards

Conflict of interest: The authors have no conflicts of interest to disclose.

Compliance with ethical principals: This research did not involve human participants or animals. No informed consent was necessary.

1. Baron J, Haskins R. The Obama Administration's evidence-based social policy initiatives: an overview. 2011. Retrieved from http://www.brookings.edu/opinions/2011/1102_budget_deficit_haskins.aspx
2. Catalano RF, Fagan AA, Gavin LE, et al. Worldwide application of prevention science in adolescent health. *Lancet*. 2012; 379(9826): 1653-1664. doi:10.1016/S0140-6736(12)60238-4.

3. O'Connell ME, Boat TF, Warner KE. Preventing mental, emotional, and behavioral disorders among young people: progress and possibilities. Washington: National Academies Press; 2009.
4. Thompson DK, Clark MJ, Howland LC, et al. The patient protection and affordable care act of 2010 (PL 111-148): an analysis of maternal-child health home visitation. *Policy, Politics, Nursing Pract.* 2011; 12(3): 175-185. doi:10.1177/1527154411424616.
5. Belfield C, Nores M, Barnett S, et al. The high/scope perry preschool program: cost-benefit analysis using data from the age-40 follow up. *J Hum Resour.* 2006; 41(1): 162-190.
6. Heckman J, Moon SH, Pinto R, et al. The rate of return to the High-Scope perry preschool program. *J Public Econ.* 2010; 94: 114-128. doi:10.1016/j.jpubeco.2009.11.001.
7. Reynolds AJ, Temple JA, Robertson DL, et al. Age 21 cost-benefit analysis of the title I Chicago child-parent centers. *Educ Eval Policy Analysis.* 2002; 24(4): 267-303. doi:10.3102/O1623737024004267.
8. Kukulinski MR, Briney JS, Hawkins JD, et al. Cost-benefit analysis of communities that care outcomes at eighth grade. *Prev Sci.* 2012. doi:10.1007/s11121-011-0259-9.
9. Beatty AS. Strengthening benefit-cost analysis for early childhood interventions workshop summary. Washington: National Academies Press; 2009.
10. Crowley DM, Hill LG, Kukulinski MR, Jones D. Research priorities for economic analyses of prevention: current issues & future directions. *Prev Sci.* 2013.
11. Karoly LA. Toward standardization of benefit-cost analyses of early childhood interventions. *SSRN Electron J.* 2011. doi:10.2139/ssrn.1753326.
12. Lee S, Aos S, Drake EK, Pennucci A, Miller GE, Anderson L. Return on investment: evidence-based options to improve statewide outcomes April 2012 update. Olympia, WA: Washington State Institute for Public Policy, 2012. Retrieved from <http://www.wsipp.wa.gov/pub.asp?docid=12-04-1201>
13. Brown CH, Kellam SG, Kaupert S, et al. Partnerships for the design, conduct, and analysis of effectiveness, and implementation research: experiences of the prevention science and methodology group. *Adm Policy Ment Health Ment Health Serv Res.* 2011. doi:10.1007/s10488-011-0387-3.
14. Crowley DM, Jones DE, Greenberg MT, et al. Resource consumption of a diffusion model for prevention programs: the PROSPER delivery system. *J Adolesc Health.* 2012; 50(3): 256-263. doi:10.1016/j.jadohealth.2011.07.001.
15. Aos S, Lieb R, Mayfield J, Miller M, Pennucci A. Benefits and costs of prevention and early intervention programs for youth, 2004: Retrieved from <http://www.wsipp.wa.gov/pub.asp?docid=04-07-3901>
16. Asemati H, Belinsky M, Gillette R, Liebman J, Sellman A, Wyse A. Social impact bonds: lessons learned so far. Santa Monica, CA: Federal Reserve Bank of San Francisco; 2013. Retrieved from <http://www.frbsf.org/community-development/files/social-impact-bonds-lessons-learned.pdf>
17. The Pew Charitable Trusts. Results first, 2012. Retrieved from <http://www.pewstates.org/projects/results-first-328069>.
18. Chalkidou K, Lord J, Fischer A, et al. Evidence-based decision making: when should we wait for more information? *Health Aff.* 2008; 27(6): 1642-1653. doi:10.1377/hlthaff.27.6.1642.
19. Drake EK, Aos S, Miller MG. Evidence-based public policy options to reduce crime and criminal justice costs: implications in Washington state. *Victims Offenders.* 2009; 4(2): 170-196. doi:10.1080/15564880802612615.
20. Costa K. Washington state shows what works data-driven analysis of public programs reaps many benefits. 2012. Retrieved from http://www.americanprogress.org/issues/2012/02/washington_what_works.html
21. Dueffert N. Better results, lower costs washington state's cutting-edge policy analysis Mod. Pew Center fo the States. 2012. Retrieved from http://www.pewstates.org/uploadedFiles/PCS_Assets/2012/ResultsFirst_Washington_casestudy.pdf
22. Results First. Achieving success with the Pew-MacArthur results first initiative a state progress report 2011-13. Washington D.C.: Pew Center fo the States, 2013. Retrieved from http://www.pewtrusts.org/~media/legacy/uploadedfiles/pcs_assets/2014/RfStateSuccessesbriefARTFINALv5pdf.pdf
23. Dodge KA, Mandel AD. Building evidence for evidence-based policy making: delinquency prevention. *Criminol Public Policy.* 2012; 11(3): 525-534. doi:10.1111/j.1745-9133.2012.00828.x.
24. Liebman J. Building on recent advances in evidence-based policy-making. Washington: Brookings Institution; 2013.
25. Greenblatt J. The promise of pay for success. *Comm Dev Invest Rev.* 2013; 9(1).
26. Liebman J, Sellman A. Social impact bonds a guide for state and local governments. Cambridge: Social Impact Bond Technical Assistance Lab; 2013.
27. Callanan L, Law J. Pay for success: opportunities and risks for non-profits. *Comm Develop Invest Rev.* 2013; 9(1).
28. Third Sector Capital Partners. Case study: preparing for a pay for success opportunity. Boston, MA: Third Sector Capital, 2013. Retrieved from http://www.thirdsectorcap.org/wp-content/uploads/2013/04/Third-Sector_Roca_Preparing-for-Pay-for-Success-in-MA.pdf
29. Valadmanis R. Massachusetts uses largest "social impact bond" to tackle crime. Reuters. New York, NY, 2013. Retrieved from <http://www.reuters.com/article/2014/01/29/us-usa-massachusetts-socialbond-idUSBREA051Q120140129>
30. Crowley M. The role of social impact bonds in pediatric health care. *Pediatrics.* 2014; 134(2): 331-333. doi:10.1542/peds.2013.4056.
31. AHRQ. U.S. Preventive Services Task Force (USPSTF): an introduction. Rockville, MD: Agency for Healthcare Research and Quality, 2012. Retrieved from <http://www.ahrq.gov/professionals/clinicians-providers/guidelines-recommendations/uspstf/index.html>
32. AHRQ. U.S. Preventive services task force procedure manual. (No. AHRQ Publication No. 08-05118-EF). Washington D.C.: Agency for Healthcare Research and Quality, 2011. Retrieved from <http://www.uspreventiveservicestaskforce.org/uspstf08/methods/procmanual.htm>
33. USPSTF. USPSTF Grade definitions after July 2012. Washington D.C, 2014. Retrieved from <http://www.uspreventiveservicestaskforce.org/Page/Name/grade-definitions#grade-definitions-after-july-2012>
34. USPSTF. Update on methods: estimating certainty and magnitude of net benefit. U.S. Preventive Services Task Force, 2014. Retrieved from <http://www.uspreventiveservicestaskforce.org/Page/Name/update-on-methods-estimating-certainty-and-magnitude-of-net-benefit#copyright-and-source-information>
35. Foster EM, Dodge KA, Jones D. Issues in the economic evaluation of prevention programs. *Appl Dev Sci.* 2003; 7: 76-86. doi:10.1207/S1532480XADS0702_4.
36. Baron J. Demonstrating how low-cost randomized controlled trials can drive effective social spending: Washington D.C.: Coalition for Evidence-Based Policy, 2013. Retrieved from <http://coalition4evidence.org/wp-content/uploads/2013/12/Low-cost-RCT-competition-December-2013.pdf>
37. Head BW. Reconsidering evidence-based policy: key issues and challenges. *Policy Soc.* 2010; 29(2): 77-94. doi:10.1016/j.polsoc.2010.03.001.
38. Karoly LA. Investing in our children: what we know and don't know about the costs and benefits of early childhood interventions. Santa Monica: Rand; 1998.
39. Kilburn K, Karoly LA. The economics of early childhood policy what the dismal science has to say about investing in children. 2008. Retrieved from http://www.rand.org/pubs/occasional_papers/OP227.html
40. Boardman AE, Greenberg DH, Vining AR, et al. Plug-in shadow price estimates for policy analysis. *Ann Reg Sci.* 1997; 31: 299-324. doi:10.1007/s001680050051.
41. Heckman J. Shadow prices, market wages, and labor supply. *Econometrica.* 1974: 679-694.
42. Vining A, Weimer DL. An assessment of important issues concerning the application of benefit-cost analysis to social policy. *J Benefit-Cost Analysis.* 2010; 1(1). doi:10.2202/2152-2812.1013
43. Jones DE, Greenberg M, Crowley M. Early social-emotional functioning and public health: the relationship between kindergarten social competence and future wellness. *Am J Public Health.* 2015; e1-e8. doi:10.2105/AJPH.2015.302630
44. Levin H, Belfield C, Muennig PA, Rouse C. The costs and benefits of an excellent education for all of America's children. New York, NY: Columbia University, 2006. Retrieved from http://www3.nd.edu/~jwarlick/documents/Levin_Belfield_Muennig_Rouse.pdf
45. Bates ME, Labouvie EW. Adolescent risk factors and the prediction of persistent alcohol and drug use into adulthood. *Alcohol Clin Exp Res.* 1997; 21(5): 944-950. doi:10.1111/j.1530-0277.1997.tb03863.x.
46. Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: implications for substance abuse prevention. *Psychol Bull.* 1992; 112(1): 64-105. doi:10.1037/0033-2909.112.1.64.
47. Duckworth AL. The significance of self-control. *Proc Natl Acad Sci.* 2011; 108(7): 2639-2640. doi:10.1073/pnas.1019725108.
48. Heckman J. Skill formation and the economics of investing in disadvantaged children. *Science.* 2006; 312(5782): 1900-1902. doi:10.1126/science.1128898.
49. Moffitt TE, Arseneault L, Belsky D, et al. A gradient of childhood self-control predicts health, wealth, and public safety. *Proc Natl Acad Sci.* 2011; 108(7): 2639-2640. doi:10.1073/pnas.1010076108.
50. Conduct Problems Prevention Research Group, Jones DE, Foster EM. Service use patterns for adolescents with ADHD and comorbid conduct disorder. *J Behav Health Services Res.* 2008; 36(4): 436-449. doi:10.1007/s11414-008-9133-3.
51. Karoly LA. Valuing benefits in benefit-cost studies of social programs. Technical Report. RAND. 2008. Retrieved from http://www.rand.org/content/dam/rand/pubs/technical_reports/2008/RAND_TR643.pdf

52. Kahn JG. The cost-effectiveness of HIV prevention targeting: how much more bang for the buck? *Am J Public Health*. 1996; 86(12): 1709-1712. doi:10.2105/AJPH.86.12.1709.
53. Cicchetti D, Rogosch FA. Equifinality and multifinality in developmental psychopathology. *Dev Psychopathol*. 2009; 8(04): 597. doi:10.1017/S0954579400007318.
54. Collins LM, Murphy SA, Strecher V. The multiphase optimization strategy (MOST) and the sequential multiple assignment randomized trial (SMART). *Am J Prev Med*. 2007; 32(5): S112-S118. doi:10.1016/j.amepre.2007.01.022.
55. Huffman WE. Allocative efficiency: the role of human capital. *Q J Econ*. 1977; 91(1): 59. doi:10.2307/1883138.
56. Collins LM, Murphy SA, Nair VN, et al. A strategy for optimizing and evaluating behavioral interventions. *Ann Behav Med*. 2005; 30: 65-73. doi:10.1207/s15324796abm3001_8.
57. Crowley DM. Building efficient crime prevention strategies considering the economics of investing in human development. *Criminol Public Policy*. 2013; 12(2): 353.
58. Feenstra TL, Hamberg-van Reenen HH, Hoogenveen RT, et al. Cost-effectiveness of face-to-face smoking cessation interventions: a dynamic modeling study. *Value Health*. 2005; 8(3): 178-190. doi:10.1111/j.1524-4733.2005.04008.x.
59. Max Crowley D, Jones DE, Coffman DL, et al. Can we build an efficient response to the prescription drug abuse epidemic? Assessing the cost effectiveness of universal prevention in the PROSPER trial. *Prev Med*. 2014. doi:10.1016/j.ypmed.2014.01.029.
60. Foster EM, Prinz RJ, Sanders MR, et al. The costs of a public health infrastructure for delivering parenting and family support. *Child Youth Serv Rev*. 2008; 30(5): 493-501. doi:10.1016/j.childyouth.2007.11.002.
61. Haddix AC, Teutsch SM, Corso PS. Prevention effectiveness: a guide to decision analysis and economic evaluation. Oxford: Oxford University Press; 2003.
62. Levin & McEwan. Cost-effectiveness analysis: methods and applications. 2000. Retrieved March 15, 2011, from http://books.google.com/books?hl=en&lr=&id=HnILG23vYDwC&oi=fnd&pg=PR15&dq=%22comparison+group*%22+in+cost-effectiveness+analysis&ots=clogG1SjI&sig=-H4khQJnQCjQPlzUAgAR-Mwsc5E#v=onepage&q=comparison%20group&f=false
63. Cost-effectiveness in health and medicine. New York: Oxford University Press. 1996.
64. Hoffmann C, Stoykova BA, Nixon J, et al. Do health-care decision makers find economic evaluations useful? The findings of focus group research in UK health authorities. *Value Health*. 2002; 5: 71-78. doi:10.1046/j.1524-4733.2002.52109.x.
65. Foster EM, Porter MM, Ayers TS, et al. Estimating the costs of preventive interventions. *Eval Rev*. 2007; 31(3): 261-286. doi:10.1177/0193841X07299247.
66. Flay BR, Biglan A, Boruch RF, et al. Standards of evidence: criteria for efficacy, effectiveness and dissemination. *Prev Sci*. 2005; 6: 151-175. doi:10.1007/s11121-005-5553-y.
67. Drummond MF. Methods for the economic evaluation of health care programmes. Oxford: Oxford University Press; 2005.
68. Aos S, Lee S, Drake EK, Pennucci A, Klima T, Millier M, Burley M. Return on investment: evidence-based options to improve statewide outcomes. 2011 Retrieved from <http://www.wsipp.wa.gov/pub.asp?docid=11-07-1201>
69. Coker A, Reeder C, Fadden M, et al. Physical partner violence and Medicaid utilization and expenditures. *Public Health Rep*. 2004; 119(6): 557-567. doi:10.1016/j.phr.2004.09.005.
70. McLellan AT. Drug dependence, a chronic medical illness: implications for treatment, insurance, and outcomes evaluation. *JAMA: J Am Med Assoc*. 2000; 284(13): 1689-1695. doi:10.1001/jama.284.13.1689.
71. Miller TR, Cohen MA, Rossman SB. Victim costs of violent crime and resulting injuries. *Health Aff*. 1993; 12(4): 186-197. doi:10.1377/hlthaff.12.4.186.
72. Cohen MA, Rust RT, Steen S, et al. Willingness-to-pay for crime control programs*. *Criminology*. 2004; 42(1): 89-110. doi:10.1111/j.1745-9125.2004.tb00514.x.
73. Miller T. Nurse-family partnership home visitation: costs, outcomes, and return on investment. Bethesda, MD: HBSA INC. 2013. Retrieved from http://www.pewstates.org/uploadedFiles/PCS_Assets/2013/Costs_and_ROI_report.pdf
74. Cohen MA. The costs of crime and justice. New York: Routledge; 2005.
75. Cohen MA. Pain, suffering, and jury awards: a study of the cost of crime to victims. *Law Soc Rev*. 1988; 22(3): 537. doi:10.2307/3053629.
76. Birch S. Cost effectiveness/utility analyses. Do current decision rules lead us to where we want to be? *J Health Econ*. 1992; 11(3): 279-296. doi:10.1016/0167-6296(92)90004-K.
77. Gold MR, Stevenson D, Fryback DG. HALYS and QALYS and DALYS, oh my: similarities and differences in summary measures of population health. *Annu Rev Public Health*. 2002; 23(1): 115-134. doi:10.1146/annurev.publhealth.23.100901.140513.
78. Finn J, Hayward J. Bringing success to scale: pay for success and housing homeless individuals in Massachusetts. *Community Development Investment Review*. 2013; 9(1).
79. Dueffert N. States' use of cost-benefit analysis improving results for taxpayers. Pew-MacArthur Results First Initiative. 2013. Retrieved from http://www.pewstates.org/uploadedFiles/PCS_Assets/2013/Pew_Results_First_State_report.pdf
80. Fagan AA, Hanson K, Hawkins JD, et al. Bridging science to practice: achieving prevention program implementation fidelity in the community youth development study. *Am J Community Psychol*. 2008; 41(3-4): 235-249. doi:10.1007/s10464-008-9176-x.
81. Gruen R, Elliott J, Nolan M, et al. Sustainability science: an integrated approach for health-programme planning. *Lancet*. 2008; 372(9649): 1579-1589. doi:10.1016/S0140-6736(08)61659-1.
82. Heinrichs N, Bertram H, Kuschel A, et al. Parent recruitment and retention in a universal prevention program for child behavior and emotional problems: barriers to research and program participation. *Prev Sci*. 2005; 6(4): 275-286. doi:10.1007/s11121-005-0006-1.
83. Dusenbury L. A review of research on fidelity of implementation: implications for drug abuse prevention in school settings. *Health Educ Res*. 2003; 18(2): 237-256. doi:10.1093/her/18.2.237.
84. Golden M. Developing a social impact bond: lessons from a provider. New York, NY: The Children's Aid Society. 2013. Retrieved from http://www.childrensaidsociety.org/files/upload-docs/CAS_FINAL_Report.pdf
85. Perkins DF, Feinberg ME, Greenberg MT, et al. Team factors that predict to sustainability indicators for community-based prevention teams. *Eval Program Planning*. 2011; 34(3): 283-291. doi:10.1016/j.evalprogplan.2010.10.003.
86. Goodman RM, Speers MA, Mcleeroy K, et al. Identifying and defining the dimensions of community capacity to provide a basis for measurement. *Health Educ Behav*. 1998; 25(3): 258-278. doi:10.1177/109019819802500303.
87. Johnson K. Building capacity and sustainable prevention innovations: a sustainability planning model. *Eval Program Planning*. 2004; 27(2): 135-149. doi:10.1016/j.evalprogplan.2004.01.002.
88. Office of National Drug Control Policy. The economic costs of drug abuse in the United States (No. Publication No. 207303). Washington D.C.: Executive Office of the President. 2004. Retrieved from https://www.ncjrs.gov/ondcppubs/publications/pdf/economic_costs.pdf
89. White D, Holand A. Benefit-cost analysis: what are states doing? Washington: Pew Center for the States; 2013.
90. Canavan T, Elovainio R. Performance based financing: an international review of the literature. Royal Tropical Institute, 2008.
91. Dugger R. Success begins with a feasibility study. *Community Development Investment Review*. 2013; 9(1).
92. Marsh K, Bertranou E, Samanata K. Cost-benefit analysis and social impact bond feasibility analysis for the Birmingham Be Active scheme. *Matric Evidence*, 2011. Retrieved from http://www.socialfinance.org.uk/sites/default/files/matrix_be_active_final_report.pdf
93. Costa K, Shah S. Government's role in pay for success. *Community Development Investment Review*. 2013; 9(1).