



# Investing in the Early Years

The Costs and Benefits of Investing in Early  
Childhood in New Hampshire

*Technical Appendixes*

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## Appendix. Methodology

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This technical appendix provides additional information about the methodology used to derive the benefit-cost results presented in the body of the report. We first discuss the analysis of the Nurse-Family Partnership (NFP) program and then the one-year preschool program.

### Estimating the Costs and Benefits of Investing in NFP

#### *Program Cost*

The estimated cost to provide the NFP model in New Hampshire for first-time mothers with income below the federal poverty level (FPL) is derived based on a budget worksheet provided by the NFP National Service Office (NSO). The budget is based on the following parameters:

- The program is staffed with eight full-time nurse home visitors along with a part-time administrator (25-percent time), full-time nurse supervisor, and a full-time data entry/support person.
- The program maintains a caseload per nurse of 25 families and follows the NFP curriculum in terms of the timing of the home visits during pregnancy and after the birth of the child.
- The average length of time that a family participates in the program is 1.7 years (Blueprints for Healthy Development, 2017).

The cost model accounts for the fixed cost for the program operations (such as facilities and annual NFP service fees), costs that vary with the nurse home visitor (for example, training and professional development, office supplies, computers and software, and cellular phone usage), and costs that vary with the number of families served (such as outreach materials, client support materials, postage, and local travel costs for the home visits). The budget assumes turnover of one nurse home visitor per year and the associated training cost for the replacement nurse. Annual salaries for nurses and other staff are based on median occupational wage data for New Hampshire as of May 2015 (Bureau of Labor Statistics, 2016), inflated to 2016 dollars based on the Consumer Price Index for All Urban Consumers (CPI-U). With these parameters, the program is estimated to cost \$4,947 per year per family served in 2016 dollars. Based on the assumption of 1.7 years of participation on average, the total cost per mother served is \$8,410. When discounted to the first year of the program, the cost is \$7,929 in present-value dollars.

We note that the NFP agency start-up costs in the first year of operation are not included in the cost estimate, which is intended to reflect steady-state operating costs. These start-up costs include the fees charged by the NFP NSO for establishing a new NFP program, including training for all program staff (and the associated travel), data and reporting system set-up, and

other program support. These fees are reflected in the budget worksheet provided by the NSO. In the first year, for the assumed program scale, the start-up fees would be approximately \$82,000.

The estimate of program cost per participant, as noted in the report, also does not include system-level costs, such as those required for program administration or ongoing monitoring and evaluation. Such resources could build on administrative systems already in place to support the Home Visiting New Hampshire (HVNH) programs, including Healthy Families America (HFA).

### *Program Impacts and Their Values*

Table A.1 summarizes the assumptions and sources for the three broad domains of impact included in the outcome estimates for the NFP program.

**Table A.1. Assumptions for Estimates for Each Type of Impact for NFP Modeling**

<b>Summary Result</b>	<b>Reduction in Health Services</b>	<b>Reduction in Child Abuse and Neglect</b>	<b>Improvement in Maternal Self-Sufficiency</b>	<b>Reduction in Crime Costs</b>
Source of estimated impact of NFP participation	Impacts on use of health services used from Washington State Institute for Public Policy (WSIPP) meta-analysis (WSIPP, undated)	Impacts on child abuse and neglect from WSIPP (undated) meta-analysis	Impacts on maternal earnings and use of social welfare programs (i.e., Temporary Assistance for Needy Families [TANF] and Food Stamps) from WSIPP (undated) meta-analysis	Impacts on reductions in maternal crime and youth crime and delinquency from WSIPP (undated) meta-analysis
Conversion to dollar benefits	Cost of emergency room visits for the United States	Lifetime cost for nonfatal child abuse and neglect for the United States in terms of health care cost, child welfare costs, and criminal justice system cost	Monthly TANF benefit for New Hampshire; monthly Food Stamp benefit for United States (does not vary by state)	Cost for criminal justice system per unit of crime and tangible crime victim costs for the United States
Assumed attenuation for New Hampshire implementation relative to NFP implementation in Elmira, N.Y.; Memphis, Tenn.; and Denver, Col.		<u>Baseline model:</u> 80% of impact <u>More conservative estimate:</u> 60% of impact <u>Less conservative estimate:</u> 100% of impact		
Assumed attenuation for TANF benefits relative to prior Aid to Families with Dependent Children program		Attenuation is 50% of impact as measured in the Elmira trial, consistent with findings in Memphis trial.		
Discount rate			3%	

NOTE: We converted all dollars to 2016 dollars using the CPI-U.

Parameters for New Hampshire or the United States include the following:

- The average cost for an emergency room visit for children under age 5, based on the 2014 Medical Expenditure Panel Survey and inflated to 2016 dollars, was \$814 (Agency for Healthcare Research and Quality, undated).
- The average lifetime cost per nonfatal child maltreatment case for short- and long-term health care costs, child welfare cost, and criminal justice cost, discounted to age 0, in 2010 dollars and inflated to 2016 dollars, was \$64,652 (Fang et al., 2012).
- The maximum benefit for a family with one adult and one child in New Hampshire in 2016 was \$606 for the TANF program (Urban Institute, 2017) and \$357 for the Supplemental Nutrition Assistance Program (SNAP) (Center on Budget and Policy Priorities, 2016).
- The societal cost of crime measured for the United States for various crime categories are from McCollister, French, and Fang (2010).

### *Accounting for Baseline Demographics, Home Visiting Participation, and Public Funding*

We assume that the target population for NFP would be first-time mothers with income below the FPL. Based on the share of first births nationally (Centers for Disease Control and Prevention, 2017), we estimate that about 4,800 births in 2015 in New Hampshire, or about 38 percent of the total, were to first-time mothers. Assuming that 12 percent have family income below the FPL (see Table 3 in the body of the report), there would be about 575 eligible births. We assume that 100 families could be recruited into the program from each cohort, a 17-percent participation rate. With overlapping cohorts, approximately 200 families would be served in each year.

As noted in the report, the HFA model is implemented in New Hampshire as part of the federal Maternal, Infant, and Early Childhood Home Visiting (MIECHV) Program. At current funding levels, the program reaches 325 families per year, again with overlapping birth cohorts for the program, which can last for up to three years. Thus, about 100 families from each birth cohort are recruiting annually. Given the number of children born each year with various child- and family-level risk factors (see Table 3), we assume that the two programs would operate together, given differences in the populations they target and the mix of services delivered.

## Estimating the Costs and Benefits of a One-Year High-Quality Preschool Program

### *Program Cost*

The estimated cost to provide a high-quality, school-day, school-year preschool program in New Hampshire is developed based on the *Provider Cost of Quality Calculator* (U.S. Department of Health and Human Services, undated). The following assumptions were used for a high-quality program:

- The program has four classrooms of 20 students, each supported by three full-time administrative staff—director, curriculum director, and administrative assistant.
- The lead teacher in each classroom has a bachelor’s degree and is paid a salary consistent with the salary for a public school kindergarten teacher; the assistant teacher has an associate’s degree and is paid a salary consistent with a public school teacher assistant.
- Each classroom’s group size of 20 children ensures a ratio of one adult for every ten children.
- The program follows other high-quality practices consistent with proven models such as the Oklahoma universal preschool program (Gormley et al., 2005) or the Boston Public Schools preschool program (Weiland and Yoshikawa, 2013).
- The program offers preschool services for six hours per day (30 hours per week) and follows an academic-year calendar (180 days).

Based on the *Provider Cost of Quality Calculator*, the cost model accounts for fixed costs for the center (such as facilities, fees and permits, telecommunications, and annual audit), as well as costs that vary with the teacher (for example, fringe benefits, professional development) and with the child (for example, nutrition, educational supplies, administrative supplies, and insurance). Annual salaries for the lead and assistant teachers are based on median occupational wage data for New Hampshire as of May 2015 for kindergarten teachers and teacher assistants, respectively (Bureau of Labor Statistics, 2016), inflated to 2016 dollars based on the CPI-U. We assume this program model could be delivered for the same program cost in the public schools or by community-based providers (for example, Head Start programs, private nonprofit programs, private for-profit programs). The estimated cost for the program with the above parameters is \$9,309 in 2016 dollars.

As noted in the report, these costs do not include system-level costs, such as for overall program administration or ongoing monitoring and evaluation. Such resources would be expected to build on administrative systems already in place to support the existing spending on child care and early learning programs in New Hampshire, such as those associated with the provider licensing process, the quality rating and improvement system (QRIS), and district-level special education preschool programs.

### *Program Impacts and Their Values*

Table A.2 summarizes the assumptions and sources for the three domains of impact included in the outcome estimates for a high-quality preschool program. Specific parameters for New Hampshire include the following:

- The special education prevalence in New Hampshire was 17.2 percent of students in public schools as of 2014 (Annie E. Casey Foundation, undated).

**Table A.2. Assumptions for Estimates for Each Type of Impact for Preschool Program Modeling**

Summary Result	School Readiness Linked to Earnings	Special Education Use	Grade Repetition
Source of estimated impact of preschool participation	Impacts on school readiness from evaluation of Tulsa, Okla., universal preschool program, school-day participants; estimates vary by family income (Bartik, Gormley, and Adelstein, 2012)	Impacts on special education use as reported in Belfield (2004, 2006), applied to baseline rate for New Hampshire	Impacts on special education use as reported in Belfield (2004, 2006), applied to baseline rate for New Hampshire
Conversion to dollar benefits	Estimates of the present-value lifetime earnings benefits from gains in school readiness derived from the Tennessee STAR class size reduction experimental evaluation, applied to New Hampshire earnings data (Bartik, Gormley, and Adelstein, 2012)	Annual cost of K–12 education in New Hampshire and Cost of special education relative to K–12 education	Annual cost of K–12 education in New Hampshire
Assumed attenuation for New Hampshire implementation relative to Tulsa, Okla., implementation		<u>Baseline model:</u> 80% of impact <u>More conservative estimate:</u> 60% of impact <u>Less conservative estimate:</u> 100% of impact	
Assumed attenuation for experiencing quality improvement but not new participation in preschool	The effect from a gain in quality is 50% as large as the effect from moving from no preschool to preschool		
Discount rate	3%		

NOTE: We converted all dollars to 2016 dollars using the CPI-U.

- The incidence of ever repeating one or more grades for students in New Hampshire was 6.3 percent as of 2011–2012 (Annie E. Casey Foundation, undated).
- The annual expenditure per pupil for public elementary and secondary schools in New Hampshire in 2013–2014 was \$14,601 (Cornman and Zhou, 2016). This figure was inflated to \$15,331 in 2016 dollars using the CPI-U for services less medical care, as recommended by Rothstein and Mishel (1997).
- The estimated present-value lifetime earnings gain (discounted to age 4) in New Hampshire from a one-percentile increase in test scores in 2016 dollars was estimated to be \$1,906. This estimate is based on findings from Chetty et al. (2011) on the causal relationship between test scores in kindergarten and adult earnings at ages 25 to 27. We adopted the same methodology employed by Bartik, Gormley, and Adelstein (2012) in their derivation of an estimate for Tulsa, Oklahoma, of the present-value gain in lifetime earnings from a one-percentile increase in test scores. Our estimate is derived from the

age-earnings profile for New Hampshire based on pooled Current Population Survey data for 2015–2016.

*Accounting for Baseline Demographics, Preschool Participation, and Public Funding*

As reported in Table 2 in the report, we assumed that there are 12,800 children in an annual cohort of four-year-olds in New Hampshire (that is, a kindergarten entry cohort), distributed by income tier as shown in Table A.3. The current preschool participation rate by income tier for 4-year-olds was reported in Figure 3 and is repeated in Table A.3. We assume that a publicly funded preschool program for children in families with income up to 300 percent of FPL would increase the participation rate to 80 percent in each income tier. As noted in the report, publicly funded preschool programs in states with universal programs have reached participation rates of this magnitude (for example, District of Columbia at 86 percent, Vermont at 84 percent, Florida at 77 percent, and Oklahoma at 75 percent) (Barnett et al., 2016).

**Table A.3. Baseline and Assumed Preschool Participation Rates by Poverty Status**

Family Income as a Percentage of FPL	Number of 4-Year-Olds	Preschool Participation Rate for 4-Year-Olds (Percentage)	
		Baseline	Assumed Steady State
<100	1,510	44	80
100–199	2,330	51	80
200–299	1,920	56	80
300 and above	7,040	80	80
Total	12,800	–	–

SOURCE: Baseline participation rate based on the 2011–2015 American Community Survey Public Use Microdata Sample (PUMS) file.

NOTE: 4-year-olds refers to those who turn 4 by September 1 and are in preschool programs one year before kindergarten entry.

– = not applicable.

Applying those participation rates to the number of 4-year-olds in the three lowest income tiers (those eligible for the state-funded preschool programs) shows the number of children who would (1) participate in Head Start, just as under the status quo; (2) shift from being nonparticipants under the status quo to participants; and (3) participate in a preschool program just as they did under the status quo (see Table A.4). For the latter group, we assume they will experience an increase in preschool program quality relative to the baseline. The cost for the state-funded preschool program is applied only to groups (2) and (3). That is to say, program costs apply for new participants (1,680 children) and to those who are assumed to experience an increase in program quality (2,263 children).

As noted in Table A.2, we assume that the group of new participants will receive the full impact of preschool participation in terms of test scores, special education use, and grade

retention. We attenuate those impacts by 50 percent for those who would have been in a preschool program under the status quo but who are assumed to experience an increase in quality with the policy change. This is likely to be a conservative assumption, given that there is evidence of threshold effects for preschool program quality (Zaslow et al., 2010). In other words, there may be little or no benefit to participation in programs of low quality under the status quo, so that moving to a high-quality program generates the same amount of impact as a child who would have had no preschool experience under the status quo.

**Table A.4. Number of Preschool Participants and Status Relative to the Status Quo by Poverty Status**

Family Income as a Percentage of FPL	Number of 4-Year-Olds Participating (80 Percent of Cohort)	Preschool Status Relative to the Status Quo		
		No Change; Participants in Head Start	New Participants	Participants in Higher-Quality Programs
<100	1,208	665	544	0
100–199	1,864	0	676	1,188
200–299	1,536	0	461	1,075
Total	4,608	665	1,680	2,263

NOTE: *4-year-olds* refers to those who turn 4 by September 1 and are in preschool programs one year before kindergarten entry. The number of 4-year-olds participating is based on an 80 percent participation rate.  
 – = not applicable.

### *Additional Results*

Table 15 in the report presents results at the cohort level for a targeted one-year preschool program under the baseline assumptions of 80-percent effectiveness of the preschool program relative to the proven state and district programs (or, alternatively, 20-percent attenuation; see Table A.2). Those same cohort-based figures under the more-conservative assumptions (specifically 60-percent effectiveness or 40-percent attenuation) are shown in Table A.5, while Table A.6 has the results under less-conservative assumptions (specifically, 100-percent effectiveness or 0-percent attenuation).

**Table A.5. Benefit-Cost Summary Results per Cohort for a Targeted One-Year Preschool Program in New Hampshire: More Conservative Assumptions**

Summary Result	By Family Income Tier			Total
	< 100% of FPL	100–199% of FPL	200–299% of FPL	
Present-value costs, in thousands of dollars	5,062	17,349	14,299	36,709
Present-value benefits, in thousands of dollars	11,923	30,895	18,895	61,713
From school readiness linked to earnings	11,275	29,382	18,895	59,552
From reduced grade retention	41	96	0	138
From reduced special education	607	1,417	0	2,024
Net present-value benefits, in thousands of dollars	6,861	13,546	4,597	25,003

NOTE: All cost and benefit estimates are from the societal perspective; that is, those costs and benefits that accrue to preschool program participants, to the public sector, and to the rest of society at large. Amounts are in 2016 present-value dollars. For a family with one adult and two children, 100 percent, 200 percent, and 300 percent of the FPL is annual income of \$19,096, \$38,192, and 57,288, respectively.

**Table A.6. Benefit-Cost Summary Results per Cohort for a Targeted One-Year Preschool Program in New Hampshire: Less Conservative Assumptions**

Summary Result	By Family Income Tier			Total
	< 100% of FPL	100–199% of FPL	200–299% of FPL	
Present-value costs, in thousands of dollars	5,062	17,349	14,299	36,709
Present-value benefits, in thousands of dollars	19,872	51,491	31,492	102,855
From school readiness linked to earnings	18,792	48,969	31,492	99,253
From reduced grade retention	69	160	0	229
From reduced special education	1,011	2,361	0	3,373
Net present-value benefits, in thousands of dollars	14,810	34,142	17,193	66,145

NOTE: All cost and benefit estimates are from the societal perspective; that is, those costs and benefits that accrue to preschool program participants, to the public sector, and to the rest of society at large. Amounts are in 2016 present-value dollars. For a family with one adult and two children, 100 percent, 200 percent, and 300 percent of FPL is annual income of \$19,096, \$38,192, and 57,288, respectively.

## References

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- Agency for Healthcare Research and Quality, “Medical Expenditure Panel Survey, Household Component Summary Tables,” Washington, D.C.: Agency for Healthcare Research and Quality, web page, undated. As of January 28, 2017:  
[https://meps.ahrq.gov/data\\_stats/quick\\_tables\\_search.jsp?component=1&subcomponent=0](https://meps.ahrq.gov/data_stats/quick_tables_search.jsp?component=1&subcomponent=0)
- Annie E. Casey Foundation, *KIDS COUNT Data Center*, website, undated. As of January 28, 2017:  
<http://www.datacenter.kidscount.org/>
- Barnett, W. Steven, Allison H. Friedman-Krauss, Rebecca Gomez, Michelle Horowitz, G. G. Weisenfeld, Kirsty Clarke Brown, and James H. Squires, *The State of Preschool 2015: State Preschool Yearbook*, New Brunswick, N.J.: National Institute for Early Education Research, 2016. As of January 28, 2017:  
<http://nieer.org/research/state-preschool-2015>
- Bartik, Timothy J., William Gormley, and Shirley Adelstein, “Earnings Benefits of Tulsa’s Pre-K Program for Different Income Groups.” *Economics of Education Review*, Vol. 31, 2012, pp. 1143–1161.
- Belfield, Clive R., *Investing in Early Childhood Education in Ohio: An Economic Appraisal*, Washington, D.C.: Center for American Progress, August 27, 2004. As of January 28, 2017:  
<https://www.americanprogress.org/issues/education/news/2004/08/27/1011/investing-in-early-childhood-education-in-ohio-an-economic-appraisal/>
- , *An Economic Analysis of Pre-K in Arkansas*, Washington, D.C.: Pre-K Now, November 2006.
- Blueprints for Healthy Development, *Nurse-Family Partnership: Program Costs*, website, 2017. As of January 28, 2017:  
<http://www.blueprintsprograms.com/program-costs/nurse-family-partnership>
- Bureau of Labor Statistics, “May 2015 State Occupational Employment and Wage Estimates: New Hampshire,” Washington, D.C.: U.S. Department of Labor, web page, March 30, 2016. As of January 28, 2017:  
<https://www.bls.gov/oes/current/oessrcst.htm>
- Center on Budget and Policy Priorities, *A Quick Guide to SNAP Eligibility and Benefits*, Washington, D.C., September 2016. As of January 28, 2017:  
<http://www.cbpp.org/sites/default/files/atoms/files/11-18-08fa.pdf>
- Centers for Disease Control and Prevention, “Stats of the States,” web page, January 17, 2017. As of January 28, 2017:  
[https://www.cdc.gov/nchs/pressroom/stats\\_of\\_the\\_states.htm](https://www.cdc.gov/nchs/pressroom/stats_of_the_states.htm)

- Chetty, Raj, John N. Friedman, Nathaniel Hilger, Emmanuel Saez, Diane Whitmore Schanzenbach, and Danny Yagan, “How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project STAR,” *Quarterly Journal of Economics*, Vol. 126, No. 4, 2011, pp. 1593–1660.
- Cornman, Stephen Q., and Lei Zhou, *Revenue and Expenditures for Public Elementary and Secondary Education: School Year 2013–14 (Fiscal Year 2014)*, Washington, D.C.: U.S. Department of Education, 2016.
- Fang, Xiangming, Derek S. Brown, Curtis S. Florence, and James A. Mercy, “The Economic Burden of Child Maltreatment in the United States and Implications for Prevention,” *Child Abuse and Neglect*, Vol. 36, 2012, pp. 156–165.
- Gormley, William T., Ted Gayer, Deborah Phillips, and Brittany Dawson, “The Effects of Universal Pre-K on Cognitive Development,” *Developmental Psychology*, Vol. 41, No. 6, 2005, pp. 872–884.
- McCollister, Kathryn E., Michael T. French, and Hai Fang, “The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation,” *Drug and Alcohol Dependence*, Vol. 108, No. 1, 2010, pp. 98–109.
- Rothstein, Richard, and Lawrence Mishel, “Alternative Options for Deflating Education Expenditures Over Time,” in William J. Fowler, ed., *Developments in School Finance*, Washington, D.C.: National Center for Education Statistics, U.S. Department of Education, 1997, pp. 161–172.
- Urban Institute, *Welfare Rules Database*, website, 2017. As of January 28, 2017: <http://wrds.urban.org/wrd/query/query.cfm>
- U.S. Department of Health and Human Services, *Provider Cost of Quality Calculator*, website, undated. As of January 28, 2017: <https://www.ecequalitycalculator.com>
- Washington State Institute for Public Policy, *Benefit-Cost Results*, website, undated. As of January 28, 2017: <http://www.wsipp.wa.gov/>
- Weiland, Christina, and Hirokazu Yoshikawa, “Impacts of a Prekindergarten Program on Children’s Mathematics, Language, Literacy, Executive Function, and Emotional Skills,” *Child Development*, Vol. 84, No. 6, November–December 2013, pp. 2112–2130.
- WSIPP—See Washington State Institute for Public Policy.
- Zaslow, Martha, Rachel Anderson, Zakia Redd, Julia Wessel, Louisa Tarullo, and Margaret Burchinal, *Quality Dosage, Thresholds, and Features in Early Childhood Settings: A Review of the Literature (OPRE 2011-5)*, Washington, D.C.: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services, 2010.