



Economic Impact Report

The Economic & Fiscal Impact on Maine of NIH-funded Medical Research

**For:
United for Medical Research**

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March 2, 2016

NIH Research Funding and Maine

In 2014, organizations in Maine received \$71.7 million in research funding from the National Institutes of Health, placing Maine in the bottom third of U.S. states in terms of NIH funding.

Yet, this money has a surprising and significant impact on the state beyond the immediate medical research and jobs directly supported. This infusion of funds helps generate sales for Maine businesses, supports downstream jobs, contributes to Maine's tax base and boosts an industry sector with an average starting salary nearly twice the statewide average.

Return on Investment:
\$192 million in sales
1,860 FTE jobs
\$13 million state, local taxes
\$47,000 avg. starting salary

Maine also benefits from NIH research funds awarded to organizations in other states. When the federal government invests strongly and consistently in medical research, there is an additional positive impact that results from NIH-supported sales by Maine companies to businesses outside the state as well as from the medical research itself and its effect on public health.

Consider Corning Life Sciences. It employs around 400 people at its Kennebunk facility, making it one of the top 10¹ private employers in York County.

Approximately 20 to 25 percent of its sales are dependent on NIH funding, with the majority of these sales to customers outside Maine. Corning, its workers and York County benefit greatly from NIH funding outside the state of Maine.

Maine Healthcare Costs:
\$5.4 billion in 2014
54% 10-yr increase
21% of total wage income
6th highest burden

Of course, the purpose of research supported by the NIH is to extend and enhance the quality of human life through better medicines, procedures, treatments and delivery systems. **Maine, more so than most other states, stands to gain from such advances.** Over the past decade, public health spending in Maine

has increased 54 percent, growing to \$5.4 billion in 2014 for Medicare, Medicaid and related programs. Maine now ranks sixth in the nation in terms of the burden of its public health spending. Improved medical treatments could save the state tens of millions of dollars.

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Increased federal funding of the NIH – enabling increased research funding to organizations in Maine and across the United States – would increase the economic impacts in Maine noted above and support the development of a more complete medical research cluster in Maine, a central part of the State of Maine's economic development strategy.

¹ Top 25 private employers in Maine by average monthly employment by county (second quarter 2015)
<http://www.maine.gov/labor/cwri/publications/pdf/MaineCountyTop25Employers.pdf>

A. Executive Summary

The fundamental public purpose of research supported by the National Institutes of Health (NIH) is extending and enhancing the quality of human life through better medicines, procedures, treatments and delivery systems. Inherent in this noble enterprise is the fact that it simultaneously improves human life by providing quality jobs and stimulating economic growth all across the country.

Maine Jobs and the Economic Multiplier

In Maine in 2014, NIH research was—directly and indirectly—the source of sales for Maine businesses of over \$192 million, an amount nearly three times the \$71.7 million in NIH grant awards the state received. These sales supported the full-time equivalent of 1,860 jobs earning pay and benefits of nearly \$94 million. These businesses and jobs were located in over 100 Maine municipalities, including all 16 counties in the state.

Report Findings

1. The total impact of NIH funding on Maine economic activity is \$192.6 million
2. The total impact of NIH funding supports 1,860 full-time equivalent jobs in Maine
3. The in-state economic activity flowing from NIH-funded research in 2014 produced nearly \$13 million in tax and fee revenue to Maine state and local governments

While most Maine recipients of NIH funds are academic institutions or non-profit enterprises, their spending flows to hundreds of Maine-based suppliers. The spending of these businesses and their employees has high impact, economic and fiscal multiplier effects. NIH-funded employees and those of all the businesses indirectly linked to NIH recipient institutions pay income taxes, sales taxes, property taxes, fuel and excise taxes and a variety of fees to the state and to the towns where they live. At the same time, all of the businesses commercially linked to NIH-funded activities pay the income, property, fuel, licensing and other business taxes and fees to which they are subject.

While most of this NIH-generated spending takes the form of operating expenses—labor and materials—over \$12 million goes for capital expenditures—buildings, equipment, vehicles and infrastructure improvements. These capital expenditures flow to architects, engineers, contractors, building supply vendors and scores of other local businesses to produce an additional indirect benefit of \$8 million.

Report Findings

4. The NIH-funded research has an extraordinarily positive impact on the overall labor market in Maine because:
 - Newly-hired employees in NIH-supported institutions and in the biopharmaceutical manufacturers associated with them¹ earn substantially more (\$46,900) than the average new hire across all Maine industries (\$25,500)
 - The number of new hires in these NIH supported sectors in Maine has grown twice as fast over the past four years (20%) as new hires for the state as a whole (10%)
 - The human capital embodied in the 206 new hires made in these NIH-related sectors in Maine in 2014 amounts to \$230 million over the course of their full careers

Perhaps most importantly of all, the core jobs supported by NIH funding—those related to research and development and biomedical production—help significantly enhance the state’s labor force. In 2014, newly hired employees in these key sectors had a median age of 31 years and an average starting salary of \$47,000, far above the state-wide starting salary of \$25,500. The rate of growth of new hires in these key sectors over the past four years, moreover, has been twice (20%) that of the growth of new hires for the state as a whole (10%).

When viewed from the perspective of their full careers, the 206 new hires made by the key NIH-related sectors in Maine represent an investment by their employers of over \$230 million in Maine’s stock of human capital. It also fully supports one of the state’s central economic development strategies—to grow the biomedical sector.

Increasing NIH funding in the future would further support this strategy. Today Maine ranks 23rd in the percentage of total NIH impact captured within the state at 77.2%. By this metric, Massachusetts ranks first, capturing 95.3% of the total economic impact of NIH-related research activity. This quite naturally follows from the fact that the Cambridge-Boston area is the hub of a world-class biomedical cluster of research and related support activities. If, as a result of increased NIH funding, Maine could achieve Vermont’s 84.5% capture rate, it would mean an additional \$9 million in sales for Maine businesses supporting additional 30 to 60 high-paying jobs.

Improving Mainers’ Health and Saving Money

Finally, Maine would benefit greatly from NIH advances in health and medical care that reduce the overall cost of healthcare. In 2014, public medical spending in Maine amounted to over \$5.4 billion—more than \$2.9 billion for Medicare and over \$2.4 billion for Medicaid and related programs. These amounts are growing rapidly and, at the state level, have become an increasingly contentious element of the biennial budget battles in Augusta.

Report Findings

5. The impact on Maine of expanding the vendor supply chain serving NIH-related industries to the level of other northern New England states would produce additional annual sales for Maine businesses of \$3 million to \$9 million supporting an additional 30 to 60 jobs
6. The improved medical treatment resulting from NIH-funded research could save tens of millions of dollars in public health care expenditures, spending that now totals over \$5.4 billion, amounts to 21% of total wage and salary earnings in the state, and ranks Maine 6th among all the states
7. That increased federal funding for the NIH would increase the economic and public health benefits to Maine

Over the past decade, this public health care spending in Maine has increased by 54%. Over the same period, wage and salary income has increased at less than half that rate (25%). This spending as a share of Maine's total wage and salary income stands at 21.0%, far above the national average of 14.9%. By this metric, Maine ranked sixth in the nation—behind only West Virginia, Mississippi, Arkansas, Kentucky and New Mexico in terms of the burden of public health spending. Clearly whatever impact NIH-funded research has on improving health outcomes in Maine will save both state and federal taxpayers tens, even hundreds of millions of dollars.

B. Introduction, Purpose and Summary Findings

The purpose of this report is to explain and document the economic impact on the State of Maine of NIH-funded research. It builds on and expands studies conducted by Dr. Everett Ehrlich in 2011 and 2015 for United for Medical Research (UMR).² In these studies, Dr. Ehrlich used a national impact model to estimate the total economic impact of NIH research grants on each of the 50 states and on the U.S. as a whole for FY 2010 and FY 2014.³

In the latest of these studies, as it applies to Maine, Dr. Ehrlich begins with the FY 2014 NIH spending in Maine of \$71.7 million. Using the RIMS II model and his own analysis, he concludes that this spending:

- ✓ Generates additional sales for Maine businesses of \$70.5 million (through in-state supply-chain linkages to vendors and in-state consumer spending of both NIH-supported employees and vendor employees) bringing the total sales impact on Maine to \$142 million;
- ✓ Supports 1,402 jobs in Maine (at the NIH-supported institutions and at the indirectly impacted Maine businesses);
- ✓ Generates additional sales for businesses outside of Maine of \$32.4 million that supports an additional 320 jobs for non-Maine residents throughout the U.S.

The report's overall conclusion, therefore, is that the total **national** impact of NIH spending in Maine amounts to sales for U.S. businesses of \$174.5 million supporting a total of 1,722 U.S. based jobs.

This report builds on these UMR reports in several ways:

1. it adds the estimated impact on Maine of non-Maine NIH awards, i.e., it estimates Maine's share of what Dr. Ehrlich calls the interstate impact of NIH spending;
2. it adds the impact of capital expenditures associated with NIH operational spending in Maine;

² United for Medical Research *An Economic Engine: NIH Research, Employment, and the Future of the Medical Innovation Sector*, 2011, <http://www.unitedformedicalresearch.com/advocacy-reports/an-economic-engine/>; and United for Medical Research, *NIH's Role in Sustaining the U.S. Economy, 2015 Update*, <http://www.unitedformedicalresearch.com/wp-content/uploads/2015/10/UMR-NIH-FY2014-Economic-Update-10.01.15.pdf>. These reports will henceforth be referred to as the UMR Economic Impact Reports for 2011 and 2015.

³ U.S. Department of Commerce, Bureau of Economic Analysis, Regional Input-Output Modeling System (RIMS II) <https://bea.gov/regional/rims/index.cfm>.

3. it adds the fiscal impact on Maine of NIH spending by estimating the total state and local taxes & fees paid in Maine by NIH-funded employees and by in-state vendors and their employees;
4. it adds a consideration of the impact of NIH-funded jobs in Maine on the state's human capital;
5. it describes how increased NIH spending in Maine could increase the share of in-state impact by making it more likely that vendors (and their employees) now included in what the national UMR impact reports call "interstate activity" would move to or expand in Maine;
6. it summarizes some of the less commercially-connected impacts of NIH funding in Maine by citing ways such funding affects health care and its fiscal impacts on the state.

The essential findings of this report are:

- ✓ that improved medical treatment resulting from NIH-funded research could save tens of millions of dollars in public health care expenditures, spending that now totals over \$5.4 billion, amounts to 21% of total wage and salary earnings in the state, and ranks Maine 6th among all the states;
- ✓ that including the in-Maine impact of outside-Maine NIH awards increases the in-Maine impact of NIH funding from \$142 million in sales to \$171 million and from 1,402 jobs to 1,685
- ✓ that including the in-Maine impact of capital expenditures associated with NIH-funded operational expenses increases the in-Maine impact of NIH funding from \$171 million in sales to \$193 million and from 1,685 jobs to 1,858;
- ✓ that the in-state economic activity flowing from NIH-funded research in 2014 produced nearly \$13 million in tax and fee revenue to Maine state and local governments;
- ✓ that NIH-funded research has an extraordinarily positive impact on the overall labor market in Maine because:
 - a. newly-hired employees in NIH-supported institutions and in the biopharmaceutical manufacturers associated with them⁴ earn substantially more (\$46,900) than the average new hire across all Maine industries (\$25,500);

⁴ NAICS Codes 5417 Scientific Research and Development Services and 3254 Pharmaceutical and Medicine Manufacturing.

- b. the number of new hires in these NIH supported sectors in Maine has grown twice as fast over the past four years (20%) as new hires for the state as a whole (10%);
 - c. the human capital embodied in the 206 new hires made in these NIH-related sectors in Maine in 2014 amounts to \$230 million over the course of their full careers;
- ✓ that the impact on Maine of expanding the vendor supply chain serving NIH-related industries to the level of other northern New England states would produce additional annual sales for Maine businesses of \$3 million to \$9 million supporting an additional 30 to 60 jobs;

C. Maine's Share of the National Interstate Impact of NIH Spending

The UMR national impact reports are based on an impact model used to estimate the economic impact of NIH awards to each of the 50 states plus the District of Columbia. It divides this impact between those that occur within each state (called the “intrastate” impact) and those that flow beyond a state’s borders (called the “interstate” impact). This methodology has the advantage of identifying both the impact of NIH awards within each state and the overall national impact. At the same time, however, it has the disadvantage of ignoring the impact within a given state of NIH awards in other states. By separating the total impact into intra- and inter-state components—an important distinction when describing the total **national** impact of the NIH—this methodology ignores the fact that all of this inter-state, national impact does, in fact, occur in individual states, just not in the same state where the award was made.

The best example of this distinction in Maine is Corning Life Sciences in Kennebunk. It employs approximately 400 workers, and between 20% and 25% of its sales are dependent on NIH funding.⁵ The majority of these sales, however, are to customers outside Maine. Some 80 to 100 of these workers, therefore, would fall into the “interstate impact” portion of the data listed in the UMR report and thus be excluded from the 1,402 “intrastate” jobs that the 2014 report identifies as the “in Maine” employment impact of NIH awards in Maine. In this way, the 1,402 jobs understates the actual employment impact in Maine of NIH funding because it excludes the in-Maine impact of NIH awards to other states, some portion of which is spent in Maine in plants such as the Corning plant in Kennebunk.

Nationally, the UMR analysis identifies a total of 68,294 such “interstate” jobs. For the purposes of this Maine-specific analysis, Planning Decisions, Inc. (PDI) assumed that Maine’s share of these “interstate jobs” was the same as its share of the national total of “intrastate” jobs (0.41%) or 282 jobs. Applying the same jobs per \$ million of sales as was true for intrastate economic activity implies additional sales to Maine businesses of \$28.6 million flowing from NIH awards made to non-Maine recipients.

In sum, including the in-Maine impact of outside-Maine NIH awards increases the in-Maine impact of NIH funding from \$142 million in sales to \$171 million and from 1,402 jobs to 1,685.

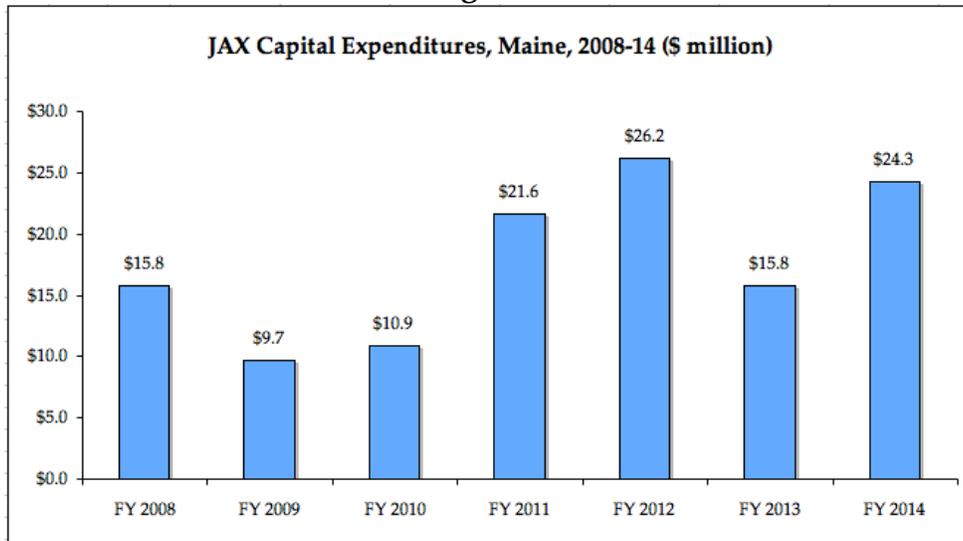
⁵ Information provided by Corning officials.

D. Impact of Capital Spending Associated with NIH Funding

The UMR reports of 2011 and 2015 start with NIH funding awarded to institutions within each state and trace the economic impacts of that spending through both the state itself and the broader U.S. economy. The vast bulk of these awards are spent on operational activities—labor, materials and the cost of operating research facilities. In addition to this operational spending, however, all NIH-funded institutions make regular expenditures for capital assets—buildings, equipment, vehicles and sophisticated software. This capital expenditure spending (capex) flows to local architects, engineers, contractors, building supply vendors and scores of other local businesses. While capex spending tends to fluctuate greatly from year to year depending on the age of buildings and equipment, a three or four year moving average of Capex spending would add substantially to the in-state economic impacts listed for each state in the UMR reports.

For Maine, a large majority—over 72% in FY 2014—of NIH funding goes to The Jackson Laboratory (JAX), a share that has held roughly steady over the past five years. Over the past four years, capex spending by JAX has averaged \$22 million.

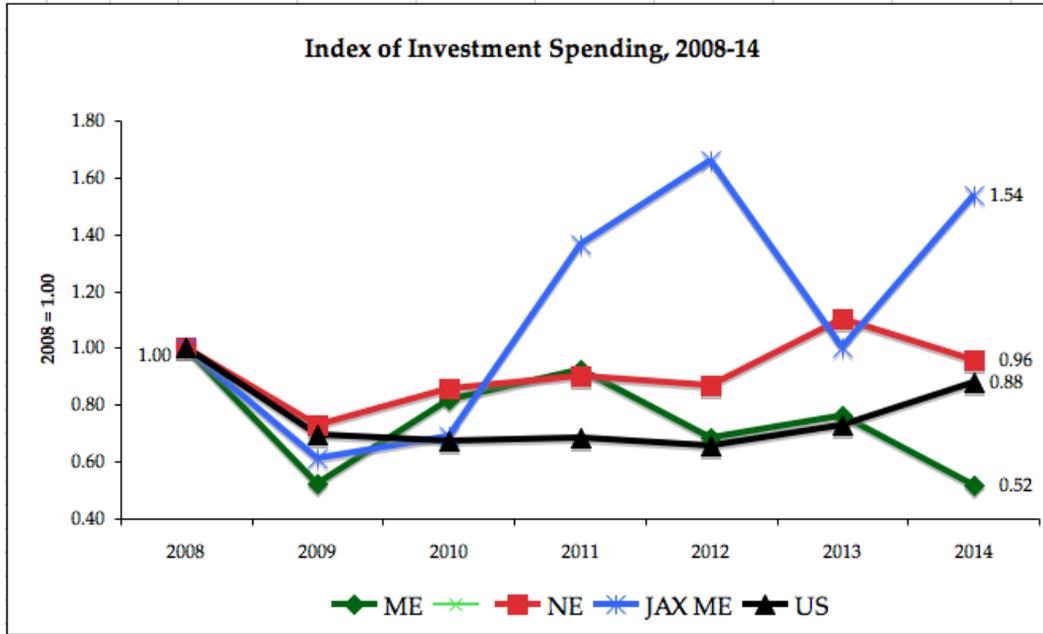
Figure 1



Source: data provided by JAX.

Over the same four-year period, average capex spending has amounted to 17% of the Lab’s average operational expenditures (opex). Perhaps even more significantly, this spending has occurred in a period of generally slow growth in which overall capital spending in the broader economy has been stagnant.

Figure 2



Source: JAX and Federal Reserve Bank of Boston.

Figure 2 compares JAX Capex with private non-residential construction contracts as reported by the Federal Reserve Bank of Boston. Setting values for each area in 2008 as 1.00 and measuring the relative year to year changes in subsequent years, it is clear that all Capex declined in the recession of 2009 and has risen since. However JAX's Capex has recovered much more rapidly and more strongly than the overall economy of Maine, New England and the U.S. This highlights the fact that NIH funded research helps provide a buffer to the vagaries of the business cycle and that medical research based investment has grown (at least at JAX) at a far greater rate than in the private economy as a whole.

Applying the 17% Capex to Opex ratio obtained from JAX to the full \$71.7 million NIH funding reported for Maine in FY 2014 implies an associated Capex spending in Maine in FY 2014 of \$12.2 million. Applying the average jobs per sales ratio for non-residential construction in Maine implies support for 93 construction-related jobs. Using the IMPLAN impact model of Maine to estimate the in-Maine indirect vendor supply chain and employee spending impacts flowing from this direct construction activity indicates additional economic activity of \$9.4 million supporting the full-time equivalent of an additional 80 jobs. Thus, the total economic impact of Capex spending in Maine amounts to total in-state economic sales of \$21.6 million and total employment of 173.

E. State & Local Fiscal Impacts Associated with NIH Funding

While most if not all recipients of NIH grant funds are non-profit enterprises, much of the money they bring to a state is ultimately taxable and flows to state and local governments. Employees supported by NIH funds and those employed by the businesses indirectly linked to those funds pay income taxes, sales taxes, property taxes, fuel and excise taxes and a variety of fees to the state and to the towns where they live. At the same time, all of the businesses commercially linked to NIH-funded activities pay the income, property, fuel, licensing and other business taxes and fees to which they are subject. Adding the \$21.6 million in Capex-related spending and the \$142 million of in-Maine economic activity that the UMR reports estimate is generated by NIH funding and the estimate of Maine's share of interstate NIH-related spending brings the total economic impact of NIH funding in Maine to \$192.3 million. Applying the IMPLAN fiscal impact model for the State of Maine to this number indicates that the total state and local tax and fee revenue traceable to NIH- initiated economic activity in FY 2014 amounted to nearly \$13 million.

**Table 3 State & Local Taxes & Fees
Attributable to NIH-generated Spending in Maine, 2014**

Category	Amount
Income Taxes	\$4,020,000
Sales Taxes	\$3,020,000
Property Taxes	\$3,904,000
Other Taxes & Fees	\$1,808,000
Total	\$12,752,000

Sources: Data derived from UMR National Reports & IMPLAN model.

F. Human Capital Impacts Associated with NIH Funding

Just as NIH-initiated investment in new plants and equipment adds to Maine's stock of physical capital (i.e., buildings and machines that will produce a return for years to come), so NIH-initiated recruitment and attraction to Maine of highly skilled employees has a significant impact on the state's labor force—its stock of human capital. And while one year's salary and benefits represents an employee's work for one year, it vastly underestimates that employee's total return over a working career.

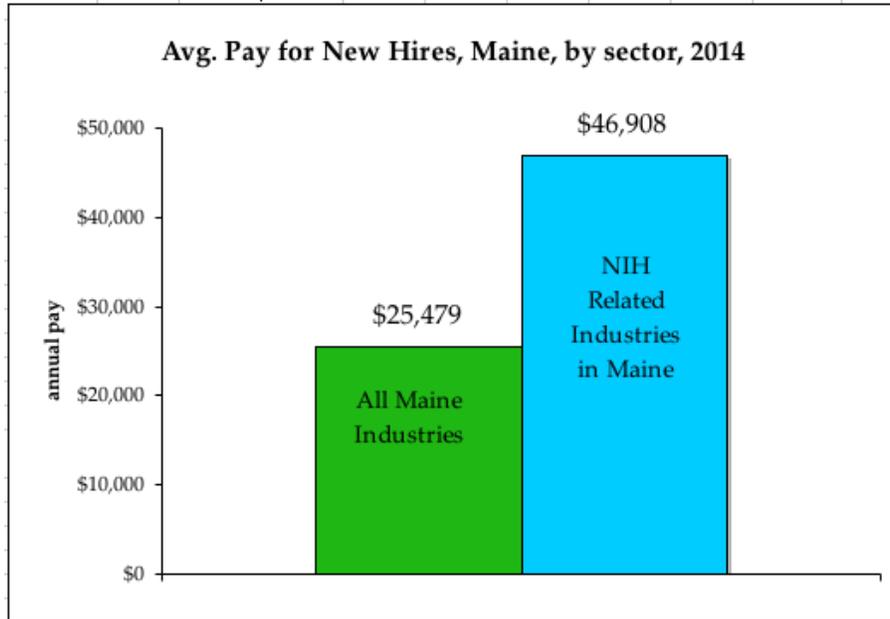
In 2014, private institutions in Maine engaged in activities related to NIH research⁶ had 206 new hires.⁷ The average earnings of these employees in 2014 amounted to \$46,900 and their median age was 31.5 years. Assuming an annual increase of 5% representing productivity and promotion increases and a conservative 20-year working career, each of those jobs represents a flow of income (in 2014 dollars) into Maine over that career of \$1.23 million. In short, hiring 206 people was tantamount to investing \$1.23 million per person, or \$230 million in Maine's human capital, a figure more than triple the \$71 million NIH operational spending in Maine and a nearly 20-fold increase over the estimated amount of physical capital invested because of NIH awards in Maine in 2014.

Further evidence of the impact of NIH-related economic activity on Maine's stock of human capital is evident when comparing the pay of new hires at NIH-research-related institutions to that of new hires at private employers in Maine as a whole.

⁶ NAICS Codes 3254 Pharmaceutical and Medicine Manufacturing and 5417 Scientific Research and Development Services.

⁷ "New hires" does not include recalls; it includes only newly hired employees who had not previously worked for the hiring entity; see qwiexplorer.ces.census.gov/.

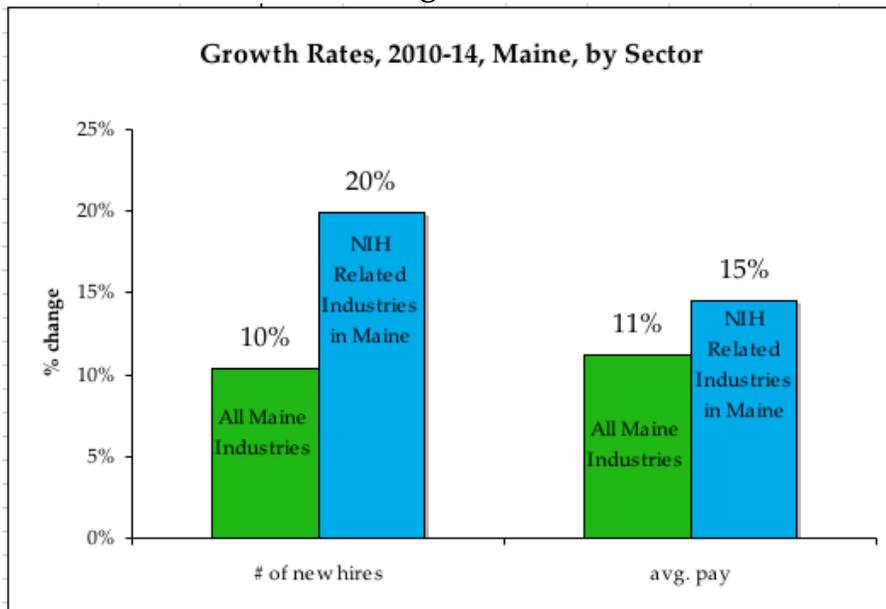
Figure 3



Sources: U.S. Bureau of the Census, Local Employment Dynamics (LED), <http://lehd.ces.census.gov/data/>. NAICS Codes 3254 Pharmaceutical and Medicine Manufacturing and 5417 Scientific Research and Development Services.

This positive impact of NIH-related economic activity in Maine is also evident in more rapid rates of growth in both the number of new hires and their average pay.

Figure 4



Sources: U.S. Bureau of the Census, Local Employment Dynamics (LED), <http://lehd.ces.census.gov/data/>.

The rate of increase in the number of new hires in NIH-related industries in Maine since 2010 has been twice the growth of new hires for the private sector as a whole. And the increase in the average pay of new hires in NIH-related industries has been substantially faster than the increase for new hires in the private sector as a whole.

G. Impact of Supply Chain Expansion Associated with NIH Funding

The UMR impact report for 2014 ranks Maine 23rd among the 50 states plus Washington, D.C. in the percentage of total NIH impact captured within the state at 77.2%. By this metric, Massachusetts ranks first, capturing 95.3% of the total economic impact of NIH-related research activity. This quite naturally follows from the fact that the Cambridge-Boston area is the hub of a world-class biomedical cluster of research and related support activities. It is also the reason that Rhode Island ranks 6th capturing 87.9% of the total economic impact of its NIH-related research activities; and Vermont ranks 10th at 84.5%; and New Hampshire 17th at 79.8%.

All of this concentration of NIH-related research in and around the Cambridge-Boston center combined with the growth in Maine noted in Figure 3 above highlights a critically important reason why Maine elected officials and policy makers should support efforts to increase overall NIH funding—its impact in attracting to Maine some of the businesses that supply NIH-supported institutions and are now located outside the state. Increasing overall NIH funding—to institutions all across the nation—would directly enhance Maine’s current economic development strategy of bringing to Maine the state some of the \$32.4 million in sales and 320 jobs now flowing to firms outside of Maine from NIH-supported research being conducted in Maine while simultaneously increasing the sales of Maine companies such as Corning that sell to NIH-funded institutions not located in the state.

If, as a result of increased NIH funding, Maine could achieve New Hampshire’s 79.8% in-state capture rate, it would mean \$3.0 million in additional sales for Maine businesses supporting an additional 30 high-paying jobs. And all this is without considering any additional direct NIH spending in Maine. Were Maine able to achieve Vermont’s 84.5% capture rate, it would mean \$9.0 million in additional sales for Maine businesses supporting an additional 57 high-paying jobs.

In short, additional NIH spending in Maine would not simply increase the existing impact as noted in the UMR reports, it would gradually expand that impact by building a more complete medical research cluster in Maine. This cluster-expanding impact is now clearly a central part of the State of Maine’s economic development strategy. Expanding NIH funding nationwide would enhance this effort enormously.

H. Impact of Medical Innovations Associated with NIH Funding

The ultimate impact of NIH-funded research is on the human beings who benefit from the innovations in medicine and health care that research provides. To those given additional years of healthy life because of its results, such research is priceless. Nonetheless, NIH funding competes in an increasingly contentious political arena for scarce public dollars, so it is useful to put such priceless outcomes into the far more prosaic budget calculus that drives public spending at both the national and state levels. In this regard, it is useful to consider the fact that in Maine in 2014, public medical spending amounted to over \$5.4 billion—more than \$2.9 billion for Medicare and over \$2.4 billion for Medicaid and other public health benefits.

These amounts are growing rapidly and, at the state level, have become an increasingly contentious element of the biennial budget battles in Augusta. Over the past decade, this public health care spending in Maine has increased by 54%. Over the same period, wage and salary income have increased at less than half that rate (25%). In 2014, public spending on health care as a share of Maine's total wage and salary income stood at 21.0%, far above the national average of 14.9%. By this metric, Maine ranked 6th in the nation—behind only West Virginia, Mississippi, Arkansas, Kentucky and New Mexico.

In short, whatever impact NIH-funded research has on improving health outcomes in Maine will save both state and federal taxpayers tens, even hundreds of millions of dollars.