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Economic Impact Assessment of Global Health on Washington State's Economy

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AUTHORS:
BILL BEYERS
JENNIFER DEVINE
SALLY WEATHERFORD
AMY HAGOPIAN

A report prepared by the Office of Global Affairs
at the University of Washington.

Special thanks to the Office of the Governor for support.

August 2007

For questions, comments or more information, please contact
Dr. Amy Hagopian at hagopian@u.washington.

To obtain an electronic copy of the report,
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Office of Global Affairs website,
www.washington.edu/home/international.

ACKNOWLEDGEMENTS

Several organizations and individuals from across the state have contributed to the completion of this economic impact study. The research team gratefully acknowledges Vice-Provost Susan Jeffords and the University of Washington Office of Global Affairs who provided both funding and leadership for this study, and the University of Washington Department of Global Health for its support.

Washington State Governor Christine Gregoire and her staff, under the leadership of Marc Baldwin, provided the motivation for this study, spurred by her vision of Washington State as an emerging worldwide leader in global health. Without the Governor's office's in-kind support, this study would not have been possible.

Governor Gregoire's vision is shared by a growing Washington State global health community, which includes several organizations that have contributed to this study:

The Global State of Washington Initiative (www.globalwa.org), an effort that aims to increase Washington State's collective impact worldwide in the areas of global health, poverty alleviation and environmental sustainability, played an instrumental role in providing data about Washington State-based global health organizations and efforts.

The Washington State Global Health Alliance has been a strong supporter of this study, exemplifying its mission of enhancing the state's global health leadership by encouraging and enabling greater collaboration through leveraging collective intellectual, technical and organizational resources. For information about the newly-founded Alliance, contact Executive Director Lisa Cohen at lcohen@washingtonglobalhealthalliance.org.

The Washington Employment Security Department, particularly Don Ayers, provided excellent support and guidance navigating state employment data. The University of Washington Office of Sponsored Programs, and the Office of Grants and Research Development at Washington State University provided data that enabled the team to analyze university research activities. Kate Kaiser, Victor Child, Barbara Gagnat and William Steiner also provided excellent research assistance. In addition to these supporters and contributors, we thank numerous individuals, such as Karin Johnson, John Linse, Katherine Barr and Guy Palmer, who provided information and shared their expertise and time to make this study possible.

CHRISTINE O. GREGOIRE
Governor

STATE OF WASHINGTON
OFFICE OF THE GOVERNOR
P.O. Box 40002 • Olympia, Washington 98504-0002 • (360) 902-4111

This report is compelling confirmation of what so many of us have long believed – that **Washington is home to one of the most vibrant, visionary global health communities in the world.**

Across the globe, states and nations are struggling to create competitive life science and global health institutions by recruiting leading companies and researchers and through significant public investments. The evidence in this report and the successes already achieved by the Washington global health community suggest that we are already leading the world through partnerships, collaboration and a shared vision of success. The recent formation of the Washington Global Health Alliance holds enormous promise for continuing and deepening Washington's leadership and collaborative spirit.

The phrase "global health community" is an important part of the story captured in this report. In Washington, this community is a combination of philanthropic organizations, non-profit research institutions, academic departments and researchers, and public agencies.

And this community is remarkable. They set a high ethical standard for activity around the world. They generate ideas, jobs and hope in the farthest corners of the globe and in communities across our state. They hold the key to much of Washington's economic future in ways that we are just starting to understand. This report is a welcome addition to that understanding.

I am grateful to the University of Washington for its work to create this report; clearly the role of our state as a leader in global health is due in no small part to the University's groundbreaking research and collaborative efforts.

Sincerely,

Chris Gregoire

Chris Gregoire
Governor, Washington

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IN WASHINGTON STATE IN 2005:

- $4.1 billion of business activity was generated by global health activities
- Nearly 3,700 jobs involved global health research and service delivery directed at low-income countries, at an average annual salary of nearly $77,600
- More than 10,100 jobs address the health needs of foreign-born residents and sovereign Indian nations living in Washington State at an average annual salary of more than $48,100
- The global health sector generated an additional 30,000 jobs through its economic impact resulting in more than 43,800 total jobs created or supported by global health activities
- $143 million of Washington's tax revenue was generated by global health activities
- More than 190 non-profit organizations promoted global health through service delivery, research, training, education and public awareness, including the Gates Foundation—the world's largest foundation
- $130.2 million in total business activity was generated by global health research and teaching at the University of Washington (UW) and Washington state University (WSU); this activity is expected to grow substantially as a result of the recent $105 million grant to the UW Institute for Health Metrics and Evaluation

WASHINGTON STATE: A LEADER IN GLOBAL HEALTH

To measure the economic impact of global health activities on Washington State's economy, an interdisciplinary research team at the University of Washington gathered information about Washington State-based companies, organizations and institutions involved in global health. This summary provides estimates of the impacts of global health activities on the state's economy for the year 2005, the last year for which complete data were available. The impacts measured in this study are limited to economic activity taking place inside Washington State and exclude the economic impacts of Washington-based organizations outside of the state. Global health activity was measured in terms of jobs created, wages paid and organization expenditures or sales, which are used in an input/output model to calculate primary and secondary economic impacts.

Many Washington State global health activities target the health concerns of low-income and low-middle income countries, referred to in this study as "developing-world health." There are also global health activities that serve populations with strong international ties living in Washington State, such as foreign-born residents and sovereign Indian nations, who make up 13.61% of the state population (US Census Data 2005). Together "developing-world health" activities serving populations in low-income countries and "domestic global health" activities serving foreign-born and sovereign Indian nations comprise this study's working definition of global health. Economic impact was measured in four sectors: for-profit, non-profit, government and higher education focusing on the University of Washington and Washington State University. Table 1 summarizes the total impact of global health activities.

TABLE 1:

ECONOMIC IMPACT OF GLOBAL HEALTH ON WASHINGTON STATE'S ECONOMY

	DEVELOPING-WORLD HEALTH	DOMESTIC GLOBAL HEALTH	TOTAL GLOBAL HEALTH
Direct Business Activity ($ MILLIONS)	$706.78	$992.56	$1,709.34
Direct Jobs: # of jobs working directly in the global health sector	3,656	10,129	13,785
Average Annual Wage/Salary per global health job	$77,557	$48,133	$55,937
Direct Labor Income: Direct wages/salaries and benefits ($ MILLIONS)	$283.55	$487.54	$771.09
Total Business Activity ($ MILLIONS)	$1,464.82	$2,658.70	$4,122.50
Total Jobs: Direct jobs and jobs supported by the industry	14,125	29,707	43,831
Total Labor Income: Wages/salaries and benefits ($ MILLIONS)	$614.66	$1,150.10	$1,764.81
Multiplier Effect: Total jobs/direct jobs	3.86	2.93	3.18
Total Tax Revenue ($ MILLIONS)	$44.99	$96.12	$143.06

Washington State's global health sector creates and supports over 43,000 jobs in Washington State and generates over $1.7 billion in salaries, wages and benefits annually. Nearly 14,000 of these jobs are "direct jobs," employing people working directly in global health. These jobs boast an average annual wage of almost $56,000—over $15,000 higher than the 2005 average annual wage or salary (QCEW Annual Data Files 2005). This high average salary/wage speaks to the quality of global health jobs and helps explain the sector's large secondary economic impacts on the state's economy captured by the multiplier effect of 3.18. An example of this large secondary economic impact is the additional 30,000 jobs supported by the global health sector state-wide.

FIGURE 1:

DISTRIBUTION OF JOBS CREATED OR SUPPORTED BY GLOBAL HEALTH ACTIVITIES BY SECTOR, 2005

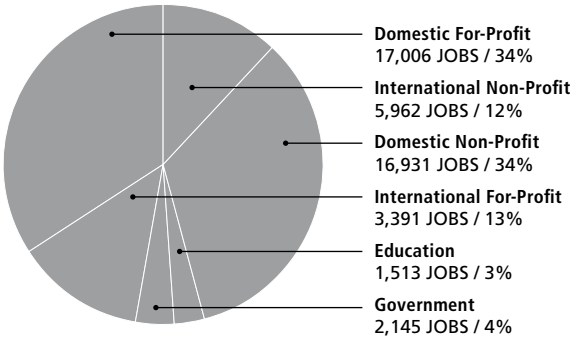
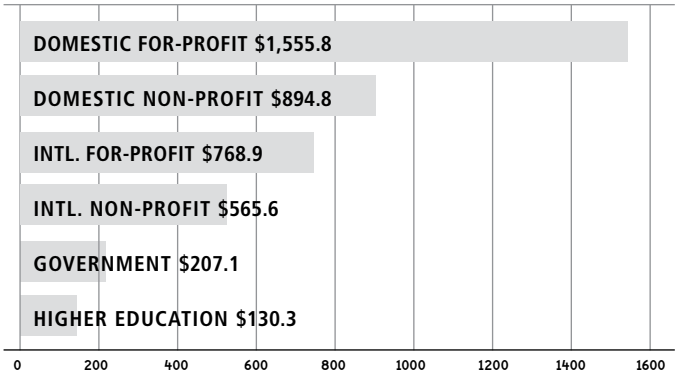


FIGURE 2:

GLOBAL HEALTH BUSINESS ACTIVITY BY SECTOR, 2005 ($ MILLIONS)



In total, nearly 17,000 for-profit jobs and more than 10,000 non-profit jobs are created or supported by companies and organizations addressing the health concerns of Washington State foreign-born residents and sovereign Indian nations. Nearly 6,000 non-profit jobs and more than 6,600 private sector jobs are created or supported by organizations and companies focusing on providing services and products that address developing-world health. Combined, there are more than 3,600 additional jobs in government and higher-education generated by Washington State's global health sector (see Figure 1).

Washington State's global health sector has a substantial economic impact in terms of business activity and sales, which includes over $1.7 billion of business activity generated directly by global health companies and organizations. Of the $4.1 billion total business activity produced by the sector, which includes primary and secondary economic impacts, over $2.3 billion is created by for-profit activities, nearly $1.5 billion is generated by the non-profit sector, and government and higher-education generate nearly $340 million in state business activity (see Figure 2).

Through a convergence of talent, ingenuity and intention, Washington State is becoming an international locus of global health activities. This study confirms that Washington State-based global health activities are not only improving the health of people all around the world and at home, but are improving the economic well-being of Washington State citizens as well. This report focuses on calculating and describing the economic impacts and benefits of Washington State's emerging status as a world leader in global health.

WHAT IS GLOBAL HEALTH?

There is no single definition of "global health," the health conditions the term addresses, or the countries in which global health activities take place. For the purposes of this study, global health activities have been categorized two ways: "**developing-world activities**" that target low-income and low-middle income countries, and "**domestic global health activities**" that serve populations with strong international ties living here in Washington State. This subset of the Washington State population includes foreign-born residents and sovereign Indian nations, who make up 13.61% of the state population (US Census 2005). Together "developing-world" and "domestic global health activities" comprise the study's working definition of global health. This approach allows this economic impact analysis to speak to various and competing definitions of global health.

The term "global health" has begun to replace the term "international health," which describes the spread of epidemics between nations or often refers solely to the health concerns that disproportionately affect the developing-world, for example, malaria, diarrhea illnesses and tuberculosis (Brown & Fee 2006, Kelley & Yach 2006, Merson 2006). While "global health" is also frequently limited to a focus on the developing-world, alternative framings suggest that global health includes health activities worldwide as "global" is understood to encompass both wealthy and resource-poor countries and their differing health needs (Beaglehole 2003). This later understanding highlights the interdependence of determinants of health such as international impacts of national health policies, transnational flows of people, goods and services, and poverty and economic opportunity in a global economy.

The growing focus on transnational determinants of health stems from a desire of the global health community to understand the effects of globalization on health worldwide. Transnational migration and global trends in urbanization, growing income inequality, and global warming all connect and influence the health of world populations (Kim et. al 2000). Several global health experts focus specifically on redressing inequality and poverty in both wealthy and low-income countries, as poverty is one of the strongest determinants of health and is influenced by processes of globalization. Emerging diseases, drug resistance, and increasing rates of chronic disease, along with the growing number of people affected by world conflict, are additional challenges being addressed by the global health community. In addition to these challenges, globalization offers new opportunities for health interventions at a global scale. Examples include efforts by organizations working transnationally to address health concerns, such as the World Health Organization, the United Nations, the World Bank, and the Global Fund.

The various definitions and foci of global health reflect attempts to understand our rapidly changing world, address global health challenges, and harness opportunities for transnational collaboration. The definitions of "developing-world health," "domestic global health," and "total global health" used in this study, while not the most simple definitions, reflect a commitment to understand the "global" in global health in a nuanced way that draws connections between Washington State and the world. These definitions also allow readers of this report to analyze the economic impact of developing-world and domestic global health activities distinctly.

I. INTRODUCTION

Through a convergence of talent, ingenuity and intention, Washington State is becoming an international locus of global health activities. Efforts by for-profit and non-profit private organizations, state government and universities have coalesced to form an entrepreneurial environment for growth in global health research, care delivery, activism and policy formation. Collectively, these diverse activities constitute a global health sector in Washington State that provides economic and educational benefits to citizens of Washington State and the world, along with the health care improvements inherent to the nature of the work itself.

Washington State's leadership stems from over 190 non-profit organizations specializing in global health activities, world-class global health research emanating from the state's universities, and hundreds of private sector companies producing goods and services addressing global health needs (Curran et. al 2007).

As global health emerges as an important source of employment, capital investment, new knowledge and pride in Washington State's economy, it is important for policy leaders to understand the nature and size of the sector. This study arose as a result of an interest of Governor Gregoire to understand the economic impact of global health efforts on the Washington economy. Increased knowledge of the sector could facilitate the development and deepening of trade relationships and partnerships, and also inform investment decisions for new resources. Stakeholders span the for-profit, non-profit, government and higher education sectors, and interest in the area covers a wide and diverse range of identities and political affiliations. As the global health sector develops and grows, it will continue to offer strong returns on new investments.

To measure the economic value of these global health activities, an interdisciplinary research team at the University of Washington has identified and collected information about Washington State's global health sector and employed an input/output model to measure the economic impact of global health. In this report, we offer estimates of the impact of global health on the state's economy for the year 2005.

A key challenge in our effort was to define and operationalize the concept of global health, a term that has several meanings and includes a broad and diffuse area of activities spanning several sectors of the economy. When organizations were involved in a wide variety of activities of which global health was only a portion, we apportioned an appropriate number of jobs or amount of economic activity to reflect their global health efforts.

A second dimension of creating a working definition of global health required our team to identify the beneficiaries or target populations of global health activities. In the process of developing the scope of work for this study, the research team decided that health services provided to immigrant populations and sovereign Indian nations should be included as a domestic component of global health to draw connections between the health of the world

and that of Washington State. The approach we have taken here is a conservative one, as global health activities implemented abroad are limited to low-income countries, and global health activities occurring in Washington State are limited to individuals with non-United States citizenship and sovereign Indian nations, who comprise 12.21% and 1.4% of the state's population respectively (US Census Data 2005).

To the best of our knowledge, this study is the first attempt to measure the economic impact of global health activities at the state level. As such, we found no model for how to accomplish this task. We describe our methodology and data sources carefully, so that this work could be repeated again in the future. The measurements offered here, therefore, provide a potential baseline against which to measure further growth in this emerging sector.

The report is organized into three main sections. Following this introduction, section II describes the study's methodology, data sources and approach by sector. Section III reports the results of the economic impact analysis in the for-profit, non-profit, government and higher-education sectors and provides the aggregated impact of Washington State's global health sector. Section IV provides concluding comments and discussion, followed by five appendices including: a technical explanation of the input/output model (Appendix I); a list of Washington State global health non-profit organizations (Appendix II); examples of global health graduate courses offered at the University of Washington and Washington State University (Appendix III); global health economic impact detailed by industry (Appendix IV); and a list of selected Washington State global health resources (Appendix V).

II. APPROACH AND DATA SOURCES

Global health concerns include a range of issues such as infectious diseases, food and water-born illnesses, health interventions and technologies, and basic health needs like nutrition and clean water and air. Table 2.1 lists examples of health issues and concerns addressed by Washington State organizations, companies and universities.

TABLE 2.1:
EXAMPLES OF GLOBAL HEALTH ISSUES

- Accidental Injury
- Chronic Disease
- Clean Water & Sanitation Access
- Food, Water Borne & Diarrheal Illnesses
- Health Care & Drug Access
- HIV/AIDS
- Malaria
- Maternal, Newborn & Child Health
- Medical Biotechnology
- Medicine & Pharmaceuticals
- Mental Health & Drug Addiction
- Nutrition
- Emerging Infectious Diseases
- Reproductive Health/Family Planning
- Tuberculosis
- Upper & Lower Respiratory Infection
- Vaccine-Preventable Diseases
- Violence Recovery

TABLE 2.2:
DEFINITIONS OF DEVELOPING WORLD HEALTH, DOMESTIC GLOBAL HEALTH AND TOTAL GLOBAL HEALTH ACTIVITIES

Developing-World Health:
Public health activities that serve populations living in low-income and low-middle income countries

Domestic Global Health:
Public health activities that serve foreign born migrants, refugees, first generation immigrants and sovereign Indian nations living in Washington State

Total Global Health:
The sum of both developing-world and domestic global health activities

This report examines both developing-world health and domestic global health activities as complementary domains of global health activities. Activities refer to public health research, service delivery, advocacy, and product development undertaken by the Washington State health community that address the health issues of people living in developing countries or a sub-group of Washington State residents who are either born abroad or belong to Native American tribes with sovereign citizenship status.

Developing-world health activities target populations living in the 112 countries classified as "low-income" or "low-middle income countries" by the World Bank's Data and Statistics Division (www.worldbank.org). "Domestic global health" activities benefit sub-populations living in Washington State that have strong international connections through mobility, citizenship, communication, and cultural and economic exchange. These Washington sub-populations include: migrants, refugees, first generation immigrants and sovereign Indian nations. Using 2005 Census data, we determined that 13.61% of Washington's population is comprised of sovereign Indian nations and foreign-born populations.

Together, developing-world health and domestic health activities comprise our working definition of global health. This approach allows us to analyze the Washington State-based efforts to improve the health in the developing world, as well as capture and highlight the state's transnational and global populations living in Washington State. The remainder of this section explains the approaches taken to measure global health activities in the private, non-profit, government and higher education sectors and the limitations of our research.

The lack of readily available data posed large research and methodological challenges. Global health activities are not defined, categorized or measured by traditional data sources like state employment agencies or federal statistical agencies such as the Census Bureau. Statistics describing international economic activity at the state and industry sector level are also limited. This challenge often resulted in analyzing firms, organizations and activities on an individual basis and limiting our scope rather than attempting an exhaustive assessment of global health activity. Other times, we made educated assumptions and estimations, which included extrapolating proxy measures from existing data. This study also excluded self-employed people, who are likely important players in the global health and domestic health markets. The economic impact of the 120 volunteer-run global health non-profit organizations was also excluded. Consequently, the analysis, while robust, likely underestimates of the economic impact of global health on the state's economy.

The data presented in this study are for a single year—2005. It would be informative to know the growth trajectory of these sectors over time. As the estimates in this report are based on employment statistics that are available for years earlier than 2005, it could be possible to develop historical data for some sectors. If we want to continue to track the growth of this sector over time, future analysis would benefit from stakeholders organizing data in a way that would make this task more straightforward. For example, large entities like the Fred Hutchinson Cancer Research Center and the University of Washington could code their grants and expenditures with regard to their global health status.

Input/output economic impact models

Economic impact studies using input/output models are most commonly used at the national, state, or regional level. These models generate "direct impacts," also called "primary economic impacts," that include the jobs, wages, sales, and taxes generated by and within the sector. The model also calculates the "indirect" and "induced impacts," or "secondary economic impacts," that are created and supported by the direct, primary economic impacts. Indirect impacts include the companies, organizations and jobs created that sell products or provide services to global heath organizations or the individuals who work in the global health sector, for example, construction companies that build offices or laboratories for global health companies or houses for global health employees. The "multiplier effect" measures the magnitude of these secondary impacts. Higher incomes create larger multiplier effects, as individuals with higher incomes have more money to inject into the economy.

The research task here was to develop data that could be used with this type of model to calculate both the primary and secondary impacts of global health activities. The data used to calculate both the primary and secondary economic impacts include: total business activity (also called output or sales), direct jobs (the number of jobs working in the sector), direct labor income (the wages/salaries and benefits paid in those jobs), other value-added components (such as profit, certain forms of taxes and depreciation), and purchases made by global health organizations and companies from other industries, called direct requirements.

For each of the for-profit, non-profit, government and higher-education components of the global health sector, we were able to calculate the number of jobs and the wages and salaries paid in those jobs. We then estimated the other required data inputs needed to run the input/output model. ºTo calculate a measure of labor income, the wage and salary data was expanded to include benefits by using the average percentage of supplements, or benefits, to wages and salaries reported by the US Bureau of Economic Analysis (BEA), which was estimated to be 23.98% (2007). To estimate total business activity, we used ratios of labor income as a fraction of sales for each industry from the 1997 Washington State input/output model, which varied for each sector and each industry within the for-profit sector (Conway 2004). Direct requirements estimates were calculated by classifying the different types of industry activities (i.e. manufacturing, services and research) into the a sectoring scheme used in the input/output model. See Appendix A for a technical discussion of input/output models.

The model then calculates the indirect impacts of purchases that industries make from each other to deliver their output to the industries whose production is "driving" the impact system. In most regional forms of these models, the impacts of consumer spending are also included, and often the impacts of state and local government expenditures are included. In this study both, have been included. Individuals in local economies spend large shares of their income locally, resulting in multiplier effects. The same is true of state and local government spending.

For-profit data sources

The private for-profit sector was the most complex sector to analyze, largely because the volume and diversity of firms is so large. In 2005, there were nearly 190,000 firms doing business in Washington State, which are classified into over 2,000 categories of codes and sub-codes in the North American Industry Classification System (NAICS) (QCEW Annual Data Files 2005). NAICS codes, as with other industry classification systems, do not include categories of business activities that are easily identified as global health activities. Our approach, therefore, was to combine a number of methods that required a large amount of investigation into the actual companies located in various NAICS codes.

We first identified the NAICS codes that potentially included global health companies working in low-income countries or with foreign-born residents and sovereign Indian nations in Washington State. We identified 50 NAICS codes where global health companies might be located, and cross-referenced this list to make sure it included the 16 NAICS codes identified as life science industries by the Puget Sound Prosperity Partnership (www.prosperitypartnership.org).

We entered into an agreement with the Washington Employment Security Department (ESD) to receive confidential employment and wage data for all establishments in our requested NAICS

TABLE 2.3:

PRIVATE SECTOR APPROACH TO MEASURING GLOBAL HEALTH ACTIVITIES

NAICS CODE	NAICS CODE TITLE	% OF ACTIVITIES RELATING TO DEVELOPING-WORLD HEALTH	% OF ACTIVITIES RELATING TO DOMESTIC GLOBAL HEALTH	% OF ACTIVITIES RELATING TO TOTAL GLOBAL HEALTH
325411	Medicinal and botanical manufacturing	9.10%	0.27%	9.37%
325412	Pharmaceutical preparation manufacturing	9.10%	0.27%	9.37%
325413	In-vitro diagnostic substance manufacturing	9.10%	0.27%	9.37%
325414	Other biological product manufacturing	9.10%	0.27%	9.37%
334516	Analytical laboratory instrument mfg.	10.70%	0.27%	10.97%
334517	Irradiation apparatus manufacturing	10.70%	0.27%	10.97%
339111	Laboratory apparatus and furniture mfg.	7.00%	0.27%	7.27%
339112	Surgical and medical instrument manufacturing	7.00%	0.27%	7.27%
339113	Surgical appliance and supplies manufacturing	7.00%	0.27%	7.27%
339114	Dental equipment and supplies manufacturing	7.00%	0.27%	7.27%
339115	Ophthalmic goods manufacturing	7.00%	0.27%	7.27%
339116	Dental laboratories	Exclude	13.60%	13.60%
423450	Medical equipment merchant wholesalers	Exclude	13.60%	13.60%
423460	Ophthalmic goods merchant wholesalers	Exclude	13.60%	13.60%
425120	Wholesale trade agents and brokers	Exclude	13.60%	13.60%
541930	Translation and interpretation services	Exclude	13.60%	13.60%
562112	Hazardous waste collection	Exclude	13.60%	13.60%
562910	Remediation services	Exclude	13.60%	13.60%
511210	Software publishers	7.40%	0.27%	7.67%
516110	Internet publishing and broadcasting	7.40%	0.27%	7.67%
541310	Architectural services	2.00%	0.27%	2.27%
541330	Engineering services	2.00%	0.27%	2.27%
541710	Physical, engineering and biological research	Companies and Organizations Individually Selected		
541720	Social science and humanities research	Companies and Organizations Individually Selected		
813211	Grantmaking foundations	Companies and Organizations Individually Selected		
813212	Voluntary health organizations	Companies and Organizations Individually Selected		
813219	Other grantmaking and giving services	Companies and Organizations Individually Selected		
813311	Human rights organizations	Companies and Organizations Individually Selected		
813312	Environment and conservation organizations	Companies and Organizations Individually Selected		
813319	Other social advocacy organizations	Companies and Organizations Individually Selected		
813410	Civic and social organizations	Companies and Organizations Individually Selected		
813920	Professional organizations	Companies and Organizations Individually Selected		
921150	Tribal governments	0.00%	20.00%	20.00%

codes for 2005. Based on analysis of firms on an individual basis, we eliminated 15 NAICS codes as unlikely to contain any businesses conducting global health activities (for example, dental laboratories and wholesale brokers). Table 2.3 contains the list of the 35 NAICS codes that were ultimately included in this study and identifies the percentage of activities determined to relate to global health. Global health activities are calculated as the sum of both developing-world and domestic global health activities.

For the majority of NAICS codes categories, we realized that most industries had some portion of their business in global health markets, although the majority of their activities focused on other markets. For example, a medical manufacturing company may sell a portion of its products to low-income countries or to international populations living in Washington State. We needed a way of identifying likely shares of these markets based on the type of industry, which required developing distinct approaches.

For the companies in NAICS codes 325411 through 339115 (health activities such as pharmaceutical manufacturing), and 511210 through 541330 (ancillary activities such as software publishing and engineering), we accessed the 1997 Washington input/output table to calculate the developing-world market shares of these companies, which were estimated from foreign market percentages (Conway 2004). We used data from the U.S. Census Statistical Abstract to determine that the U.S. export markets to low-income countries was 30.5%, one-third of which was sales in Mexico (2007). We then multiplied the Washington State foreign export market share by 30.5% for each of the NAICS codes to estimate global health markets of selected industries, which are detailed in Table 2.3.

To calculate the domestic global health market share of these for-profit industries we first calculated the share of industry markets that was domestic (subtracting foreign export sales from total sales). As the Statistical Abstract data exist at the national level, we estimated Washington State's share of the national domestic market. Given that Washington State is approximately 2% of the U.S. population (six million divided by 300 million persons), and 13.61% of the state's population is in our domestic global health sub-population, we arrived at .27% as an estimate for our Washington State domestic global health market (.27% = 2% x .136).

The industries classified in NAICS codes 339116 through 562910 (wholesale medical equipment and environmental health services) have a localized market, primarily at the state level, and no developing-world health markets. As such, we reasoned that companies in these NAICS codes had 13.61% of their market share targeted at our international populations living in Washington State.

To estimate the share of health markets for NAICS codes 511210 (software), 516110 (internet publishing), 541310 (architecture), and 541330 (engineering) in developing countries, we used the share of health spending in developing countries as a share of gross domestic product, estimated to be 5.6% by the Progressive Policy Institute (www.ppionline.org). We used this percentage on the grounds that the use of these services in developing countries could be proportional to the health share of GDP.

For NAICS codes 541710 through 81392 (ranging from physical and social research to civil society organizations), we concluded that given the diversity of organizations and companies in these codes that we would have to examine each individual entity. Using a double-coding method, each entity's business purpose description or mission statement was examined and coded to determine if the organization was engaged in global health activities in low-income countries or in Washington State. When necessary, we estimated a percent of the business or organization's activities likely to be engaged in global health work.

Tribal governments (NAICS 921150) were estimated to have 20% of their total business activity associated with health. This estimate is based, in part, on the report entitled "Economic Contributions of Indian Tribes to the Economy of Washington State" that estimates five percent of tribal employees are employed directly to provide health care services and another 20% are employed to provide "other services" we consider to address health concerns, such as child welfare services or housing for substance abuse patients (Tiller & Chase 1997). Combined with consultation with additional key informants familiar with this sector, we estimated a conservative 20% of tribal government activity as addressing the health needs of sovereign Indian nations.

Non-profit data sources

We identified approximately 15,000 non-profit organizations with offices located in Washington State using the National Center for Charitable Statistics and the Washington State Charities databases. We read the mission statement of each individual organization, available from the databases or online, to determine if the organization met the study's definition of global health. From the over 15,000 total organizations, we identified more than 190 organizations that address global health concerns in developing countries or work with international populations living in Washington State. Appendix II provides a list of these organizations.

Of these 190 plus organizations, only 68 were identified in the employment security data as employing waged or salaried workers, which suggests that the majority of these organizations are volunteer run. Of the 68 organizations with employees, 37 focus their efforts on low-income countries and 31 provide health services to international populations living in Washington State. Several organizations, such as the Fred Hutchinson Cancer Research Institute, are included in both developing-world and domestic global health activities, but we were careful not to "double count" activities of non-profit organizations that work internationally and domestically.

Employment and financial information is publicly available for non-profits with incomes greater than $100,000 and total assets greater than $250,000. Employment and financial information is not available, however, for non-profits that operate with smaller incomes and assets as well as private foundations and charitable trusts. As such, we obtained employment data on the 68 non-profits with employees through our agreement with the Washington Employment Security Department to capture economic activities of both small and large non-profit organizations.

Government data sources

Estimates of government activity related to global health assumed Washington State government health expenditures and employment would focus primarily within the state and would benefit international residents as a slice of the total state population (such as providing health care for refugees and migrant workers). For NAICS code 923120 (government administration of health programs), we estimated the percentage of government health spending benefiting international and native populations at 13.61%, the percentage of this sub-population of the state's total population. We used ESD data to obtain the number of jobs in this sub-industry and the respective wages and salaries of those jobs. Again, these figures were used to estimate additional data of labor income, sales, and direct requirements for the input/output model. Government domestic global health activity was considered to be structurally similar to professional services and management, so we estimated the direct requirements from this sector as part of the impact estimates.

Higher-education data sources

We analyzed Washington State's two largest public universities to identify global health research and teaching activities benefiting or taking place in low-income countries. Our focus on developing-world health activities and the University of Washington (UW) and Washington State University (WSU) stems from the lack of existing, comprehensive databases of university teaching and research activities. To identify research activities, we compiled a complete list of all 7,000 externally funded research and outreach projects at the University of Washington and Washington State University for the fiscal year 2006 (July 2005-June 2006), which was the closest data match to the 2005 employment data. We then reviewed each project individually and identified 278 projects that addressed global health issues in low-income countries and calculated their economic impact.

In addition to research, we also analyzed global health teaching activities at UW and WSU at the graduate level. Existing research conducted by the UW International Health Program Curriculum Committee was supplemented by online research to identify 41 developing-world health courses taught at the UW. At WSU, 13 classes were identified through online research of the WSU course catalog and through communication with WSU faculty (see Appendix III for all UW and WSU courses). From total credit hours of courses, we extrapolated the number of full-time teaching appointments associated with global health teaching activities at UW and WSU. Data from a 1997 Technology Alliance study of technology-based industry in Washington State helped us to estimate the direct requirements of university research activity in the Washington economy (Beyers & Nelson 1997).

Only research projects and courses predominately addressing developing-world health concerns at the University of Washington and Washington State University were included in this study. As such, the economic impact assessment of university global health activities is largely underestimated.

III. RESULTS – ECONOMIC IMPACTS

In this section we report the direct, primary economic impacts of global health activities on Washington State's economy as well as total economic impacts which are the primary impacts plus the secondary economic impacts. These economic impacts are also disaggregated into the for-profit, non-profit, government and university sectors. The data on direct, primary economic impacts describes the jobs, wages/salaries and benefits and business activity of only those organizations and companies working directly in global health. Secondary economic impacts capture the effect of the direct, primary economic impacts on the larger Washington State economy, for example, the additional sales, jobs created and taxes generated outside the global health sector.

Primary, direct economic impacts are described and categorized as: **direct business activity** (direct sales or output), **direct jobs** (the number of jobs working directly in the global health sector), **average annual wage/salary**, **direct labor income** (wages/salaries and benefits of direct jobs), and **other value-added** (includes tax payments, profits, and depreciation allowances).

Table 3.1 provides an overview of the primary and total economic impacts of the for-profit, non-profit, government and academic sectors of global health activities on Washington State's economy. We found that over 3,600 global health jobs focus on low-income countries, and over 10,100 jobs address domestic global health issues. These 13,700 direct jobs generate $770 million in direct labor income. Developing-world health jobs have a high average annual salary/wage of $77,600. Most of these jobs are in the biomedical and physical research and development. Domestic global health jobs, which are primarily service rather than research-oriented, also boast a high average annual salary/wage of $48,100. In 2005, the annual wage or salary for both developing-world and domestic global heath activities was nearly $56,000 which was over $15,000 above the state's annual wage average of $40,705 (QCEW Annual Data Files 2005).

TABLE 3.1:
ECONOMIC IMPACT OF GLOBAL HEALTH ON WASHINGTON STATE'S ECONOMY

	DEVELOPING-WORLD HEALTH	DOMESTIC GLOBAL HEALTH	TOTAL GLOBAL HEALTH
Direct Business Activity ($ MILLIONS)	$706.78	$992.56	$1,709.34
Direct Jobs: # of jobs working directly in the global health sector	3,656	10,129	13,785
Average Annual Wage/Salary per global health job	$77,557	$48,133	$55,937
Direct Labor Income: Direct wages/salaries and benefits ($ MILLIONS)	$283.55	$487.54	$771.09
Total Business Activity ($ MILLIONS)	$1,464.82	$2,658.70	$4,122.50
Total Jobs: Direct jobs and jobs supported by the industry	14,125	29,707	43,831
Total Labor Income: Wages/salaries and benefits ($ MILLIONS)	$614.66	$1,150.10	$1,764.81
Multiplier Effect: Total jobs/direct jobs	3.86	2.93	3.18
Total Tax Revenue ($ MILLIONS)	$44.99	$96.12	$143.06

Indirect, secondary economic impacts of global health activities are combined with the primary, direct impacts to describe the total economic impact on the state's economy and are categorized as **total business activity** (total sales or output), **total jobs**, **total labor income** and **taxes**. The indirect and induced secondary economic impacts calculated by the input/output model are grouped into large, aggregated industry groupings such as manufacturing, construction and wholesale and resale trade. This tells us how the global health sector impacts these other large components of the state economy. Tax revenue impacts are limited to state sales tax, business activity subject to state business and occupation (B&O) taxes, and state sales taxes indirectly generated through the spending of labor income. These tax revenue impacts exclude significant local government impacts that were beyond the scope of this study.

In addition to primary, direct economic impacts, the global health sector has large secondary impacts. As detailed in Table 3.2, the total economic impact of global health generates $4.1 billion in total business activity, creates and supports nearly 44,000 jobs, generates more than $1.7 billion in total labor income, and more than $143 million in tax revenue. Appendix IV further details these impacts by sub-industry.

TABLE 3.2:
TOTAL ECONOMIC IMPACT OF WASHINGTON STATE'S GLOBAL HEALTH SECTOR BY INDUSTRY

	DEVELOPING-WORLD HEALTH	DOMESTIC GLOBAL HEALTH	TOTAL GLOBAL HEALTH
TOTAL BUSINESS ACTIVITY ($ MILLIONS)			
Natural Resources & Utilities	$64.24	$107.10	$171.36
Manufacturing & Construction	$252.37	$273.50	$525.91
Wholesale & Retail Trade	$126.00	$354.10	$480.06
Services	$1,022.20	$1,923.00	$2,945.23
Total	**$1,464.81**	**$2,657.70**	**$4,122.55**
TOTAL JOBS: Direct jobs and jobs supported by the industry			
Natural Resources & Utilities	298	521	819
Manufacturing & Construction	1,136	1,562	2,698
Wholesale and Retail Trade	1,752	5,252	7,004
Services	10,939	22,371	33,310
Total	**14,124**	**29,707**	**43,831**
TOTAL LABOR INCOME: Wages/salaries and benefits ($ MILLIONS)			
Natural Resources & Utilities	$12.13	$20.6	$32.74
Manufacturing & Construction	$61.82	$64.6	$126.46
Wholesale & Retail Trade	$48.23	$130.4	$178.62
Services	$ 492.48	$934.5	$1,426.99
Total	**$614.66**	**$1,150.1**	**$1,764.81**
TAXES ($ MILLIONS)			
State Business & Occupation (B&O) Tax	$10.09	$21.60	$31.73
Direct State Sales Tax	$36.90	$74.40	$111.33
Indirect Sales Tax (Labor income)	19.65	39.80	59.49
Total	**$46.99**	**$96.10**	**$143.06**

For-profit economic impact

The for-profit global health sector directly employs 1,300 people focusing on the health concerns of low-income countries and nearly 5,500 people addressing health issues of foreign-born and sovereign Indian nations here in Washington State. Of the 1,300 developing-world jobs that target low-income countries, nearly 700 are in professional services and management, just over 200 are in the information sector, and 145 are in manufacturing. An additional 180 jobs are in chemical manufacturing, 51 in computer and electronic products, and 27 in other services. For domestic global health for-profit companies, 2,950 of the total 5,460 jobs are in professional services, 2,075 are in wholesale trade, 185 are in manufacturing, and 190 are in the information sector. The for-profit domestic health sector is dominated by businesses engaged in wholesaling medical equipment into Washington markets, and professional service firms estimated to be serving Washington markets.

TABLE 3.3:
DIRECT ECONOMIC IMPACT OF THE FOR-PROFIT GLOBAL HEALTH ECONOMIC SECTOR

	DEVELOPING WORLD HEALTH	DOMESTIC GLOBAL HEALTH	TOTAL GLOBAL HEALTH
Direct Business Activity: Sales, output or revenue ($ MILLIONS)	$335.23	$653.75	$998.98
Direct Jobs: Number of jobs working directly in the global health sector	1,301	5,462	6,763
Average Annual Wage/Salary per for-profit global health job	$97,294	$49,652	$73,473
Direct Labor Income: Total wages, salaries and benefits of direct jobs ($ MILLIONS)	$126.53	$271.19	$397.72
Other Value Added: Tax payments, profits, depreciation allowances ($ MILLIONS)	$57.52	$137.94	$195.46

In total, for-profit global health activities directly create nearly 6,800 jobs, produce nearly $999 million in sales, and generate over $397 million in wages/salaries and benefits. The average salary or wage in developing-world global heath jobs that are primarily research-oriented is more

Examples of Washington State Global Health For-Profit Company Activities

Micronics, Inc. is one of the leading developers of disease diagnosis, prognosis and treatment monitoring technology. In collaboration with local non-profit and university partners, Micronics has helped miniaturize complex, diagnostic tests onto a credit card size disposable device. The resulting 'lab-on-a-card' holds enormous potential for improving diagnostic capabilities in low-income countries with limited diagnostic laboratory facilities.

Bio Research Laboratories is a leading provider of diagnostic tests to detect autoimmune diseases, blood viruses, infectious diseases and clinical bacterial that are developed for the global market. Global health activities include sanitation services, hazardous waste characterization, and toxicity testing.

Acucela Inc. seeks to discover new drug therapies for eye diseases that affect quality of life for over 50 million people worldwide, which include: macular degeneration, glaucoma, and retinitis pigmentosa.

For more examples, visit www.globalwa.org/research-reports-and-outputs-1 or http://www.wabio.com/industry/directory.

than $97,000, and domestic global health for-profit jobs pay nearly $50,000. The higher average global health wage for the for-profit sector of $74,500 has a high multiplier effect on the broader economy, which creates large secondary, indirect impacts, described in Table 3.4.

TABLE 3.4:
TOTAL ECONOMIC IMPACT OF WASHINGTON STATE'S FOR-PROFIT GLOBAL HEALTH SECTOR BY INDUSTRY

	DEVELOPING-WORLD HEALTH	DOMESTIC GLOBAL HEALTH	TOTAL GLOBAL HEALTH
TOTAL BUSINESS ACTIVITY ($ MILLIONS)			
Natural Resources & Utilities	$34.39	$64.67	$99.01
Manufacturing & Construction	$187.99	$174.94	$362.93
Wholesale & Retail Trade	$65.72	$259.40	$325.13
Services	$480.82	$1,056.77	$1,537.6
Total	**$768.93**	**$1,555.76**	**$2,324.72**
TOTAL JOBS: Direct jobs and jobs supported by the industry			
Natural Resources & Utilities	152	322	472
Manufacturing & Construction	781	1,019	1,800
Wholesale & Retail Trade	900	3,909	4,809
Services	4,818	11,681	16,499
Total	**6,650**	**16,931**	**23,581**
TOTAL LABOR INCOME: Wages/salaries and benefits ($ MILLIONS)			
Natural Resources & Utilities	$6.31	$12.66	$18.97
Manufacturing & Construction	$47.09	$42.19	$89.28
Wholesale & Retail Trade	$25.09	$94.04	$119.13
Services	$230.58	$512.42	$743
Total	**$309.07**	**$661.30**	**$970.38**
TAXES ($ MILLIONS)			
State Business & Occupation (B&O) Tax	$5.38	$11.58	$16.96
Direct State Sales Tax	$20.12	$42.84	$62.96
Indirect Sales Tax (Labor income)	$10.71	$22.91	$33.61
Total	**$25.50**	**$54.42**	**$79.92**

The primary and secondary economic impacts of private sector global health activities create and support nearly 23,600 jobs, primarily in services, but also in trade, manufacturing and natural resources. These jobs generate over $970 million in labor income for Washingtonians. In addition to employment and labor income, the economic impact in terms of total sales and tax generation are also substantial. The private sector generated more than $2.3 billion in total business activity and nearly $80 million tax revenue.

Non-profit sector impacts

Washington State is home to more than 190 non-profit organizations addressing global health concerns worldwide, both in low-income countries and in Washington State. After the private sector, the global health non-profit sector has the largest economic impact on our state's economy of the four sectors analyzed in this report. These organizations range from the world's largest foundation, the Bill and Melinda Gates Foundation to organizations staffed by only one or two people. As described in table 3.5, Washington's non-profit sector has a substantial, direct economic impact on the state's economy, creating over 5,800 non-profit global heath jobs, over $570 million in revenue, and paying over $281 million in labor income to Washington-based employees. The annual wage/salary of non-profit organizations addressing global health concerns averaged over $57,900, with jobs focusing on low-income countries paying an average $71,700 and jobs focusing on the health needs of international populations living in Washington State paying $44,107, on average.

TABLE 3.5:
DIRECT ECONOMIC IMPACT OF THE NON-PROFIT GLOBAL HEALTH ECONOMIC SECTOR

	DEVELOPING-WORLD HEALTH	DOMESTIC GLOBAL HEALTH	TOTAL GLOBAL HEALTH
Direct Business Activity:			
Sales, output or revenue ($ MILLIONS)	**$232.02**	**$338.81**	**$570.83**
Direct Jobs:			
Number of jobs working directly in the global health sector	**1,782**	**4,050**	**5,832**
Average Annual Wage/Salary per non-profit global health job	**$71,763**	**$44,107**	**$57,935**
Direct Labor Income:			
Total wages, salaries and benefits of direct jobs ($ MILLIONS)	**$102.75**	**$178.646**	**$281.39**
Other Value Added:			
Tax payments, profits, depreciation allowances ($ MILLIONS)	**$38.74**	**$45.46**	**$84.21**

Domestic non-profit global health jobs are largely classified within health services. These organizations provide health care and services to foreign-born immigrants, migrants, refugees and sovereign Indian nations. Nearly all of the identified domestic global health jobs (4,024 of 4,050) are located in the health services industry. The non-profit, developing-world health sector is dominated by jobs located in professional services and management (1,462 of 1,782) and other services (241 of 1782). Based on conversations

Examples of Washington State Global Health Non-Profit Organization Activities

As a partner with ministries of health in several developing countries, **Health Alliance International** (HAI) strengthens government health systems, especially for AIDS treatment and child survival. With HAI's help, the number of patients on anti-retroviral treatment in Mozambique has more than doubled, from 27,000 in June of 2006 to almost 60,000 by the summer of 2007.

Each year, about 57 million women worldwide give birth without the help of a trained health worker. Some 1,600 women per day die from complications associated with pregnancy or childbirth, and infection is a leading cause. The **Program for Appropriate Technology in Health** (PATH) created disposable delivery kits that contain a plastic sheet to cover the ground where the baby will land, and a clean razor blade for cutting the umbilical cord. Small local companies around the world are now manufacturing these kits at prices poor women can afford. Between 1994 and the end of 2005, for example, more than a million kits were sold in Nepal.

With more that 70 scientists focused solely on malaria, the **Seattle Biomedical Research Institute** is home to one of the largest malaria research programs in the United States. SBRI researchers have made fundamental discoveries, with the goal of developing a vaccine suitable for pregnant women and children. The program relies on emerging technologies and the recently completed genomic DNA sequence of the most virulent malaria parasite, Plasmodium falciparum.

For more examples, see Appendix V.

TABLE 3.6:

TOTAL ECONOMIC IMPACT OF WASHINGTON STATE'S NON-PROFIT GLOBAL HEALTH SECTOR BY INDUSTRY

	DEVELOPING-WORLD HEALTH	DOMESTIC GLOBAL HEALTH	TOTAL GLOBAL HEALTH
TOTAL BUSINESS ACTIVITY ($ MILLIONS)			
Natural Resources & Utilities	$24.75	$33.30	$58.05
Manufacturing & Construction	$53.02	$79.20	$132.22
Wholesale & Retail Trade	$47.50	$77.30	$124.80
Services	$440.33	$705.00	$1,145.33
Total	**$565.60**	**$894.80**	**$1,460.40**
TOTAL JOBS: Direct jobs and jobs supported by the industry			
Natural Resources & Utilities	124	154	278
Manufacturing & Construction	291	437	728
Wholesale & Retail Trade	672	1,098	1,770
Services	4,875	8,943	13,818
Total	**5,962**	**10,631**	**16,593**
TOTAL LABOR INCOME: Wages/Salaries and Benefits ($ MILLIONS)			
Natural Resources & Utilities	$4.87	$6.10	$10.97
Manufacturing & Construction	$12.10	$18.00	$30.10
Wholesale & Retail Trade	$18.24	$29.70	$47.94
Services	$209.32	$345.50	$554.82
Total	**$244.53**	**399.30**	**$643.83**
TAXES ($ MILLIONS)			
State Business & Occupation (B&O) Tax	$3.73	$8.40	$12.13
Direct State Sales Tax	$12.76	$25.80	$38.56
Indirect Sales Tax (Labor income)	$6.83	$13.80	$20.63
Total	**$16.50**	**$34.20**	**$50.70**

with key informants, we estimated that 35% of the Fred Hutchinson Cancer Research Center (FHCRC) and 5% of overall activity at the Benaroya Research Institute at Virginia Mason targets health concerns of low-income countries. In addition to the direct economic impacts of the non-profit global health sector, the secondary, indirect economic impacts are also impressive. These total economic impacts of non-profit global health activities are detailed in Table 3.6.

In addition to the 4,050 people working directly in non-profit domestic global health, the sector supports an estimated additional 10,600 jobs statewide. The 1,800 jobs directly associated with developing-world health activity, and the related spending, are estimated to support a total of nearly 6,000 jobs statewide. Sales of $338 million by global health non-profits lead to over $1.46 billion in business activity, and the secondary impact of global health non-profits generate over $643 million in total labor income. An estimated $50 million accrues to state government through selected tax revenues for this non-profit component of the global health sector.

Government sector impact

Government global heath activities include local, state, and federal administration of public health care programs organized and implemented in Washington State, primarily at the county level. As these activities are carried out in Washington to benefit state residents, there is no developing-world global health component for this sector. To estimate the domestic global health slice of government health programs, we used 13.61% as the percentage of total government activity that benefit foreign-born and sovereign Indian nations. As detailed in Table 3.7, we identified over 600 people directly employed in the public sector addressing the health concerns of international populations living here in Washington State. The average salary or wage paid in these jobs averaged over $61,000. The over 600 state employees who are directly employed in domestic global health activities earn nearly $40 million in wages, salaries and benefits. Washington State global health activities emanating from state government created over $85 million of business activity.

TABLE 3.7:

DIRECT ECONOMIC IMPACT OF THE WASHINGTON STATE GOVERNMENT GLOBAL HEALTH SECTOR

	TOTAL GLOBAL HEALTH
Direct Business Activity:	
Sales, output or revenue ($ MILLIONS)	**$85.29**
Direct Jobs:	
Number of jobs working directly in the global health sector	**617**
Average Annual Wage/Salary per government global health job	**$61,088**
Direct Labor Income:	
Total wages, salaries and benefits of direct jobs ($ MILLIONS)	**$37.70**
Other Value Added:	
Tax payments, profits, depreciation allowances ($ MILLIONS)	**$14.32**

Examples of Washington State Global Health Government and Sovereign Nation Activitie

The 1854 Puyallup Treaty of Medicine Creek promised the Puyallup people the U.S. government would provide health care in perpetuity. The **Puyallup Tribal Health Authority** was established in the early 1970's, during a time of growing unrest about the quality of services being provided under treaty obligation. As one of the first Indian "Self-Determination Clinics," the tribe's medical clinic has grown from a mobile home to a beautiful facility with culturally designed buildings. The staff of over 200 well-trained professionals and technicians provides nationally accredited health care to an active patient population exceeding 8,500.

The International Medicine Clinic at King County's **Harborview Medical Center** provides limited-English speaking adult refugees and immigrants with quality primary care services. Staff speak the languages most commonly encountered in the clinic: Amharic, Cambodia, Cantonese, Chao Jo, Mandarin, Hmong, Laotian, Mien, Oromo, Somali, Tigrinya, and Vietnamese.

For more examples, visit www.aihc-wa.org or www.doh.wa.gov.

These direct government economic impacts, in turn, support an additional 1,500 jobs to total over 2,100 jobs working in or supported by government activities in domestic global health (see Table 3.8). These employees earn nearly $90 million through earnings and benefits and help generate more than $207 million in total business activity attributed to government global health activities benefiting Washington residents with strong international ties or sovereign status as Native Americans.

TABLE 3.8:

TOTAL ECONOMIC IMPACT OF THE WASHINGTON STATE GOVERNMENT GLOBAL HEALTH SECTOR BY INDUSTRY

	TOTAL GLOBAL HEALTH
TOTAL BUSINESS ACTIVITY ($ MILLIONS)	
Natural Resources & Utilities	$9.17
Manufacturing & Construction	$19.42
Wholesale and Retail Trade	$17.33
Services	$161.24
Total	**$207.11**
TOTAL JOBS: Direct jobs and jobs supported by the industry	
Natural Resources & Utilities	46
Manufacturing & Construction	106
Wholesale & Retail Trade	245
Services	1,747
Total	**2,145**
TOTAL LABOR INCOME: Wages/salaries and benefits ($ MILLIONS)	
Natural Resources & Utilities	$1.80
Manufacturing & Construction	$4.43
Wholesale & Retail Trade	$6.66
Services	$76.62
Total	**$89.51**
TAXES ($ MILLIONS)	
State Business & Occupation (B&O) Tax	$1.70
Direct State Sales Tax	$5.78
Indirect Sales Tax (Labor income)	$3.10
Total	**$7.48**

University impacts

The analysis of global health activities taking place in education is limited to developing-world health research and graduate-level teaching at the University of Washington and Washington State University. Despite this narrow focus, the estimated economic impact of university-based global health activities—like the for-profit, non-profit and government sectors—is the first of its kind and thus, provides a first glimpse into the economic benefits of our world-class research institutions holding a competitive advantage in global health research and education. As detailed in Table 3.9, even this limited university global health activity produces over $54 million in business activity in the state, over 570 jobs directly working on health concerns affecting low-income countries, and over $29 million in earnings and benefits. The average salary or wage paid in higher education to global health researchers and teachers was nearly $51,000.

TABLE 3.9:
DIRECT ECONOMIC IMPACT OF THE HIGHER-EDUCATION GLOBAL HEALTH SECTOR

	TOTAL GLOBAL HEALTH
Direct Business Activity: Sales, output or revenue ($ MILLIONS)	**$54.24**
Direct Jobs: Number of jobs working directly in the global health sector	**573**
Average Annual Wage/Salary per university global health Job	**$50,873**
Direct Labor Income: Total wages, salaries and benefits of direct jobs ($ MILLIONS)	**$29.15**
Other Value Added: Tax payments, profits, depreciation allowances ($ MILLIONS)	**$3.91**

Examples of Washington State Global Health University Activities

The **International Training and Education Center on HIV (I-TECH)**, based at the University of Washington, receives federal funding to train health workers in developing countries how to administer high quality care for AIDS patients. In the Caribbean island of Haiti, for example, one of the poorest countries in the hemisphere, physicians, nurses, and pharmacists have been trained to diagnose HIV and administer care.

Washington State University's **Zoonosis Research Unit** is a world-wide leader in the diagnosis, treatment and prevention of zoonotic infectious diseases—animal diseases capable of infecting humans. Research efforts include the transmission of the West Nile virus, avian influenza, antibiotic resistant bacteria like Salmonella, and the transmission of agents through surface irrigation water.

For more examples, visit www.depts.washington.edu/deptgh/ghrc/index.html or www.research.wsu.edu.

The combined primary and secondary economic impacts of UW's and WSU's global health activity includes a total of more than 1,500 jobs created or supported by university-based global health activity, and more than $61 million in wages, salaries and benefits. The overall economic impact of university global health activities also generates $130 million in business activity and $5 million in state sales and business and occupation (B&O) tax.

TABLE 3.10:
TOTAL ECONOMIC IMPACT OF THE HIGHER-EDUCATION GLOBAL HEALTH SECTOR BY INDUSTRY

	TOTAL GLOBAL HEALTH
TOTAL BUSINESS ACTIVITY ($ MILLIONS)	
Natural Resources & Utilities	$5.10
Manufacturing & Construction	$11.36
Wholesale & Retail Trade	$12.78
Services	$101.05
Total	**$130.29**
TOTAL JOBS: Direct Jobs and Jobs Created by the Industry	
Natural Resources & Utilities	22
Manufacturing & Construction	64
Wholesale & Retail Trade	180
Services	1,246
Total	**1,513**
TOTAL LABOR INCOME: Wage/salaries and benefits ($ MILLIONS)	
Natural Resources & Utilities	$0.95
Manufacturing & Construction	$2.63
Wholesale & Retail Trade	$4.90
Services	$52.58
Total	**$61.06**
TAXES ($ MILLIONS)	
State Business & Occupation (B&O) Tax	$0.97
Direct State Sales Tax	$1.92
Indirect Sales Tax (Labor income)	$2.12
Total	**$5.00**

IV. CONCLUDING COMMENTS

This first-ever economic impact study of Washington's global health sector demonstrates that global health is a significant driver of our state's economy. Washington State's global health sector creates and supports over 43,000 jobs in Washington State and generates over $1.7 billion in salaries, wages and benefits annually. Nearly 14,000 of these jobs are "direct jobs," employing people working directly in global health. These jobs boast an average annual wage of almost $56,000—nearly $16,000 higher than the 2005 average annual wage or salary (QCEW Annual Data Files 2005). This high average salary/wage speaks to the quality of global health jobs and helps explain the sector's large secondary economic impacts on the state's economy captured by the multiplier effect of 3.18. An example of this large secondary economic impact is the additional 30,000 jobs supported by the global health sector state-wide.

In total, nearly 17,000 for-profit jobs and over 10,000 non-profit jobs are created or supported by companies and organizations addressing the health concerns of Washington State foreign-born residents and sovereign Indian nations. Nearly 6,000 non-profit jobs and over 6,600 private sector jobs are created or supported by organizations and companies focusing on providing services and products that address developing-world health. Combined, there are over 3,600 additional jobs in government or higher education generated by Washington State's global health sector.

Washington State's global health sector has a substantial economic impact in terms of total business activity and sales. Of the $4.1 billion total business activity produced by the sector, more than $2.3 billion is created by for-profit activities, nearly $1.5 billion is generated by the non-profit sector, and government and higher education create nearly $340 million in state business activity

How does the global health sector compare with other sectors of our economy? Based on this report, it generates one-fifth the activity of the hospital industry in Washington State, which provides approximately $3.8 billion in employee compensation, (Beyers 2003). The sector generates twice the activity of the state's aluminum industry, which generates about $441 million in total labor income (Conway 2000) and the arts sector in Western Washington, which creates $419 million in total labor income and just over $1 billion in total business activity (Beyers 2003a).

There is widespread agreement that the global health sector, while not one of the largest economic engines in Washington State, is growing rapidly. Given that this is an area of economic activity requiring a highly educated workforce, advocates agree on the importance of investing in education for current and future workers in this sector. Further, those investments need to be along the continuum from preschool through higher education.

While the for-profit sector boasts the largest economic impact, nearly 70 non-profit organizations provide jobs in Washington State that address the health needs of people living in low-income countries and Washington State residents with strong international ties. We identified an additional 120 plus organizations engaged in global health activities that are volunteer run. This finding suggests an opportunity to continue to grow Washington State's global health leadership through targeting further economic development of non-profit activities.

More importantly, Washington State's global health sector provides a valuable contribution to the world and the health of people living in our state. Global health endeavors lend themselves to a new arrangement where mutual and reciprocal interests between low-income countries and the United States can be pursued with a sense of solidarity rather than charity. The research, teaching, service and advocacy capacity of Washington State organizations, when deployed in service to struggling health systems around the globe, can have huge benefits for all involved. Strategies developed for fighting tuberculosis, malaria or AIDS in Africa or South-East Asia will reverberate in and strengthen our own health systems, as well as improving health for populations around the world. In sum, further developing Washington State's global health leadership holds significant potential and worthwhile economic and non-economic benefits.

Our state is world-renowned for producing apples, airplanes and software. In the very near future, cures, vaccines and medicines addressing the world's most pressing health concerns may be added to that list.

APPENDIX I.
TECHNICAL NOTES ON THE INPUT-OUTPUT MODEL

The impact estimates developed in this study stem from the utilization of an "input-output model." Models of this type are based on static, cross-sectional measures of trade relationships in regional or national economies. They document how industries procure their inputs and where they sell their outputs. Pioneered by Wassily Leontief, who won the Nobel Prize in Economic Science for his insights into the development of input-output models at the national level, these models have become "workhorses" in regional economic impact analysis in recent decades.

Washington State is fortunate to have a rich legacy of research developing input-output models. Early work was led by Philip J. Bourque and Charles M. Tiebout. Input-output models have now been estimated in Washington State for the years 1963, 1967, 1972, 1982, 1987 and 1997. No other state in the U.S. has this rich historical legacy of survey-based or quasi-survey based regional input-output models. The current is based on work completed in 1994 by a team of Washington State government staff and Richard Conway, Jr. .

Input-output models decompose regional economies into "sectors"–groups of industries with a common industrial structure. The heart of these models is "Leontief production functions," which are distributions of the cost of producing the output of sectors. Leontief augmented the national accounts schema developed by Kuznets (also a Nobel laureate in economics) to take into account the significant levels of intermediate transactions that occur in economic systems in the process of transforming raw materials and services into "finished products" or "final products." Sales distributions among intermediate and final sources of demand are used as the accounting bases for the development of the core innovation of Leontief: that these relationships can be used to link levels of final demand to total industrial output by way of a system of "multipliers" that are linked through the channels of purchase in every industry to the production of output for final demand.

This system of relationships is based on accounting identities for sales. Mathematically, the system may be represented as follows. For each industry we have two balance equations:

(1) $X_i = x_{i,1} + x_{i,2} + ... + x_{i,n} + Y_i$

(2) $X_j = x_{1,j} + x_{2,j} + ...+ x_{n,j} + V_j + M_j$

where: X_i =total sales in industry i,

X_j = total purchases in industry j

$x_{i,j}$ = intermediate sales from industry i to industry j

Y_i = final sales in industry i

M_j = imports to sector j

V_j = value added in sector j.

For any given sector, there is equality in total sales and total purchases:

(3) Xi = Xj when i=j.

This system of transactions is generalized through the articulation of Leontief production functions, which are constructed around the columns of the regional input-output model. They are defined in the following manner.

Let us define a regional purchase coefficient:

ri,j = xi,j/Xj.

Rearranging,

xi,j = ri,jXj

Substituting this relationship into equation (1) we have:

(4) Xi = ri,1X1 + ri,2X2+ .... + ri,nXn + Yi

Each sector in the regional model has this equation structure, and since the values of Xi equal Xj when i=j, it is possible to set this system of equations into matrix notation as:

(5) X = RX + Y

This system of equations can then be manipulated to derive a relationship between final demand (Y) and total output (X). The resulting formulation is:

(6) X = (I-R)-1Y

where the (I-R)-1 matrix captures the direct and indirect impacts of linkages in the input-output model system. The input-output model utilized in the modeling for this research project was developed by a committee led by Dr. Richard Conway, and published in 2004 by the Washington State Office of Financial Management (Conway 2004). This model was released using both SIC and NAICS definitions. In the present study the NAICS version of the model has been used.

A major issue that surrounds the estimation of the (I-R)-1 matrix is the level of "closure" with regard to regional final demand components, which are personal consumption expenditures, state and local government outlays, and capital investment. It is common practice to include the impacts of labor income and the disposition of this income in the form of personal consumption expenditures in the multiplier structure of regional input-output models. The additional leveraging impact of these outlays is referred to as "induced" effects in the literature on models of this type. It is less common to include state and local government expenditures in the induced effects impacts, but it can be argued that demands on state and local governments are proportional to the general level of business activity and related demographics. In contrast, investment is classically argued to be responsive to more exogenous forces, and is not a simple function of local business volume. In the model that we developed for this impact study we have included personal consumption expenditures as a part of the induced-demand linkages system. We have considered Washington personal consumption expenditures to be a function of labor income. The resultant Leontief inverse matrix is displayed in this appendix.

APPENDIX II.
WASHINGTON STATE GLOBAL HEALTH NON-PROFIT ORGANIZATIONS

Domestic Global Health

American Indian Health Commission For WA State
Asia & Pacific Islander Women & Family Safety Center
Asian Counseling and Referral Service
C.I.E.L.O. Project/Radio Ranch
Campus Kitchens Project, Inc., The
Center for Multicultural Health
Chaya
Children's Benefit Foundation, Inc.
Consejo Counseling and Referral Service
Consejo Housing Development Association
Cross Cultural Health Care Program
Entre Hermanos
Farm Worker Pesticide Project
Forks Community Council
Foundation for Multicultural Solutions
Hanford Environmental Health Foundation Inc.
Indochina Chinese Refugee Association
International Community Health Services
International Drop-in Center
Kin On Community Health Care
Kin On Health Care Center
La Esperanza Health Counseling Services
National Alaska Native American Indian Nurses Association
National Asian Pacific Center on Aging (NAPCA)
Neighborhood House Inc.
Nikkei Concerns
Northwest Immigrants Rights Project
Office of Rural and Farmworker Housing
Okanogan Behavioral Healthcare
Planet Guru Foundation For South Asian Community
Puget Sound neighborhood Health Centers
Puyallup National Health Authority
Sea-Mar Community Health Center
Seattle Indian Health Board
Somali Community Services of Seattle
The Native Project
Therapeutic Health Services
Volunteers of America Northwest Washington
Washington Asian-Pacific Islander Families Against Substance Abuse
Yakima Valley Farm Workers' Clinic

Developing-World Health

3P Foundation USA
Africa Christian Training Institute
Agathos Foundation
AGROS International
AHOPE for Children
Aid Cambodia
Alpine Ascents Foundation
American Friendship Foundation
Amigos de Santa Cruz Foundation
ANCOP Foundation (USA), Inc.
Answered Prayers
Balkan Outreach
Bill & Melinda Gates Foundation
Blue Nile Children's Organization, The
Boeing Company Charitable Trust
Breakthrough Partners
Bremerton Rotary Foundation
Cambodia Tomorrow, Inc. DBA Cambodia Tomorrow
Care To Help Project
ChildCare International
Children of Chernobyl, Ellensburg
Children of the Nations
Children's Arbor Fund, The
Children's Care International
Children's Chance for Life
Children's House International
Christians Respecting Indigenous Societies/CRIS Foundation
Coalition for Charitable Choice
Displaced Orphans International, Inc.
Eagles on Assignment
East African Center or the Empowerment of Women and Children
Educational Resources Ukraine
El Buen Pastor Fund
Embrace Guatemala
Empty Vessel Ministry Foundation
Eppard Vision
Esperanza Of The Americas
For the Children of the World
Foundation For The Orphanage Of The Virgin Of Guadalupe
Fred Hutchinson Cancer Research Center
Fred Hutchinson Cancer Research Center Foundation
Friends Of IMPACTA
Friends of the Jose Carreras International Leukemia Foundation
Friends of the Nelson Mandela Foundation
Gaiseni Compassionate Ministries
Gateway Medical Alliance
Georgian-American Public Health Foundation
Giving Anonymously
Global Burn Care & Reconstructive Institute
Global ENT Outreach
Global ENT Outreach
Global HIV Vaccine Enterprise Secretariat

Developing-World Health Organizations (Continued)

Global Outreach Distribution
Global-Help Organization
Gloria Meek-Garlick Foundation
Gondar Mutual Association of Seattle
Good Samaritan International
Goodwill Physicians
Haiti Relief
Haitian Health Allies
Healing the Children
Health Alliance International
Health Emergent International Services
Helping and Loving Orphans
Hepatitis Resources Network
ICF International Childrens Foundation
Im Jai Foundation
Infectious Disease Research Institute
Institute for Systems Biology
International Action Ministries
International Care Ministries
International Children's Care, Inc.
International Children's Drive
International Children's Outreach Network
International Christian Outreach and Relief Group
International RRP Information Support and Advocacy Center
International Smile Power Foundation
International Society of Mine Safety Professionals
Intracranial Hypertension Research Foundation
Ivory Coast Medical Relief Team (ICMRT)
Kidstown International, Inc.
Kind-Hearts Child Aid Development Organization
Lake Forest Park Rotary Charitable Foundation
L'Arche USA
Latvian Association of the State of Washington, The
Lead International Ministry Network
Leprosy Research Foundation
LifeNets - Puget Sound
Lightshine
Living Earth Institute
Mama Maria Kenya
Maasai Environmental Resource Coalition
Masaka Children's Fund
Massai Association
Massai Health Systems
MBO Development Foundation
MEDRIX
Mission and Welfare Society-India
Mission Vietnam
New World Villages
Northwest Kenyan Community Association
Northwest Lions Eyeglass Recycling Center
Operacion Esperanza
Operation Eyesight Universal (USA)
Orcas Island Lions Foundation, The
Organic Seed Alliance
Partners for Health
PeaceTrees Vietnam
People International
Physicians for Social Responsibility
Planet Earth Foundation
Poulsbo-North Kitsap Rotary Foundation
Prakash Foundation
Program for Appropriate Technology in Health (PATH)
Prosthetics Outreach Foundation
PsyCorps
Pups for Peace
Pura Vida Partners
Pure Religion In Action Ministries
Pyramids
Rabour Village Project
Rose International Fund For Children, The
Roses And Rosemary
Rotary Club of Poulsbo - North Kitsap
Rotary Club of Seattle & Surrounding Areas
Seattle Biomedical Research Institute
Seattle East Timor Relief Association
Servants to Missions
Share in Asia
Shared Hope International
Shrifan Clinic Foundation
Slum Doctor
Somali Rights Network
South American Dream Builders Foundation, The
Starfish Ministries
Surgical Implant Generation Network
Tents For India
Thurston Santo Tomas Sister County Assoc
Tibetan Healing Fund
Transcultural Nursing Society
Transverse Myelitis Association
Uplift International
Village Reach
Virginia Mason Research Center, Benaroya Research Institute
Washington Physicians for Social Responsibility
Washington State Environmental Health Association
Water And Sanitation Health
Wings Worldwide, The Air Medical Foundation
Women's Enterprises International
World Aid
World Medical Fund USA
World Outreach Ministries Foundation
World Vision, Inc.

APPENDIX III.
EXAMPLES OF UNIVERSITY OF WASHINGTON AND WASHINGTON STATE UNIVERSITY GRADUATE LEVEL COURSES IN GLOBAL HEALTH

UW DEPARTMENT	NAME OF COURSE
Anthropology	Anthropology of Women's Health and Reproduction
Anthropology	Cultural Aspects of International Development
Anthropology	Human-Primate Interface: Implications for Global Health and Primate Conservation
Anthropology	Clinically Applied Anthropology
Bioengeenering	Special Projects: Biotechnology and World Health: Focus on Africa
Center for Health Sciences Inter-professional Education	Advanced Interdisciplinary Case Studies in Global Health
Center for Health Sciences Inter-professional Education	Introduction to International Health
Center for Health Sciences Inter-professional Education	International Health Class
Center for Studies in Demography & Ecology	Sustainability: People, Institutions, Knowledge, and the Environment
Center for Studies in Demography & Ecology	Population Metrics in Global Health
Evans School of Public Affairs	Development Management in the 21st Century: Humanitarian Relief and International Development
Evans School of Public Affairs	Managing Policy in a Global Context
Evans School of Public Affairs	Topics in International Affairs: The Role of NGOs in International Development
Evans School of Public Affairs	Topics in International Affairs: Program Analysis and Evaluation in the Developing World
Evans School of Public Affairs	The Role of Scientific Information in Environmental Decision Making
Family Medicine	Health & the Global Environment
Geography	Environmental Change and Human Health
Geography	Medical Geography
Health Services	Qualitative Methods
Health Services	Problems in International Health
Health Services	Reproductive Health, Population and Development
Health Services	Global Population Health and Development
Health Services	Emerging Infections
Health Services	Research Methods in Developing Countries
Health Services	Maternal and Child Health in Developing Countries
Health Services	Global Population Health and Development
Health Services	International AIDS Program Planning and Evaluation
Industrial Engineering	Humanitarian Logistics

UW DEPARTMENT	NAME OF COURSE
Medical History & Ethics	Human Genomics: Science, Ethics and Society
School of Law	Health and Human Rights
School of Medicine	Advanced Global Health
School of Medicine	Tropical Medicine
School of Nursing	Study of International Health
School of Public Health & Community Medicine	Emerging Infections of International Public Health Importance
School of Public Health & Community Medicine: Epidemology	AIDS: A multidisciplinary approach
School of Public Health & Community Medicine: Epidemology	Epidemiology of Infectious Diseases in Resource-Limited Countries
School of Public Health & Community Medicine: Epidemology	Nutrition in Developing Countries
School of Public Health & Community Medicine: Epidemology	Emerging Infections of International Public Health Importance
School of Public Health & Community Medicine: Epidemology	Maternal Child Health in Developing Countries
School of Public Health & Community Medicine: Epidemology	International Health Program Seminar
UW Center for AIDS & STDS	Principles of STD and HIV Research Course

WSU DEPARTMENT	NAME OF COURSE
Anthropology	Medical Anthropology
Health Policy and Administration	Health Care Economics
Health Policy and Administration	Comparative International Health Care
Nursing	Plateau Tribes: Culture and Health
Nursing	The Human Experience of Diversity and Health
Nursing	Nursing Education in a Multicultural Society
Nursing	International, Interdisciplinary, and Transcultural Health Care
Sociology	Demography
Sociology	Human Ecology
Sociology	Medical Sociology
Veterinary Medicine	Advanced Topics in Microbiology, Parasitology, or Immunology
Veterinary Medicine	International Veterinary Medicine
Veterinary Medicine	International Field Studies

APPENDIX IV:
TOTAL GLOBAL HEALTH ECONOMIC IMPACTS DETAILED BY INDUSTRY

INDUSTRY	TOTAL BUSINESS ACTIVITY: TOTAL SALES OR REVENUE	TOTAL JOBS: TOTAL NUMBER OF CREATED AND SUPPORTED BY THE GLOBAL HEALTH SECTOR	TOTAL LABOR INCOME: TOTAL WAGES, SALARIES AND BENEFITS
Crop production	$18.46	346	$6.08
Animal production	$12.38	129	$3.51
Forestry and fishing	$6.41	68	$2.56
Logging	$5.52	34	$1.53
Mining	$8.14	35	$1.55
Electric utilities	$70.74	122	$10.39
Gas utilities	$34.73	23	$2.50
Other utilities	$14.99	62	$4.61
Construction	$144.90	1118	$46.21
Food manufacturing	$56.08	229	$8.61
Textiles and apparel	$3.33	46	$1.18
Wood product manufacturing	$18.92	97	$4.35
Paper manufacturing	$16.36	53	$3.23
Printing	$17.66	173	$6.34
Petroleum and products	$74.14	13	$1.02
Chemical manufacturing	$86.18	212	$20.43
Nonmetallic mineral products mfg.	$9.30	58	$2.39
Primary metals	$2.63	7	$0.40
Fabricated metals	$7.40	48	$2.08
Machinery manufacturing	$2.92	20	$1.00
Computer and electronic product	$18.27	125	$8.49
Electrical equipment	$0.69	4	$0.20
Aircraft and parts	$0.52	2	$0.12
Ship and boat building	$0.99	7	$0.46
Other transportation equipment	$0.95	5	$0.24
Furniture	$5.32	49	$1.67
Other manufacturing	$59.37	431	$18.04
Wholesale trade	$209.13	2,697	$72.40
Retail trade	$270.93	4,306	$106.23
Transportation and warehousing	$78.29	577	$25.01
Information	$225.41	959	$106.22
Finance and insurance	$154.69	1,117	$47.88
Real estate	$212.53	1,335	$31.23
Professional services and management	$1,242.48	9,767	$543.55
Educational services	$80.71	1,047	$38.73
Health services	$670.87	8,133	$327.58
Arts, recreation, and accommodation	$46.00	801	$17.05
Food services and drinking places	$94.11	2,170	$33.09
Other services	$140.14	2,450	$52.58
State Government	$1,097.29	4,956	$204.06
Total	$4122.55	43,831	$1,764.81

APPENDIX V:
SELECTED WASHINGTON STATE GLOBAL HEALTH RESOURCES

AGROS International
www.agros.org

American Indian Health Commission for Washington State
aihc-wa.org

Asian Counseling and Referral Service
www.acrs.org

Bill & Melinda Gates Foundation
www.gatesfoundation.org/default.htm

Chaya
www.chayaseattle.org/

Consejo Counseling and Referral Service
www.consejo-wa.org

Fred Hutchinson Cancer Research Center
www.fhcrc.org

Global Washington Initiative
www.globalwa.org

Harborview Medical Clinic,
International Medicine Clinic
www.uwmedicine.org

Health Alliance International
depts.washington.edu/haiuw

Hepatitis Resources Network
www.h-r-n.org

Infectious Disease Research Institute
www.idri.org

Institute for Systems Biology
www.systemsbiology.org/

International Community Health Services
www.ichs.com

International Smile Power Foundation
www.smilepower.org

PATH
www.path.org

Prosthetics Outreach Foundation
www.pofsea.org

Puget Sound Partners for Global Health
www.pspgh.org

Puyallup National Health Authority
www.eptha.com

Sea-Mar Community Health Center
www.seamar.org

Seattle Biomedical Research Institute
www.sbri.org/Home

Seattle Indian Health Board
www.sihb.org

Surgical Implant Generation Network
www.sign-post.org

University of Washington,
Department of Global Health
sphcm.washington.edu/globalhealth

University of Washington, Global Health Resource Center
www.depts.washington.edu/deptgh/ghrc/index.html

University of Washington, Office of Global Affairs
www.washington.edu/home/international

Uplift International
www.upliftinternational.org

Village Reach
www.villagereach.org

Washington Biotechnology and Biomedical Association
www.wabio.com

Washington State Department of Health
www.doh.wa.gov

Washington State Global Health Alliance
Contact: Executive Director, Lisa Cohen
lcohen@washingtonglobalhealthalliance.org

Washington State University Office of Research
www.research.wsu.edu

World Vision
www.worldvision.org

Yakima Valley Farm Worker's Clinic
www.yvfwc.com

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