

THE CONTRIBUTIONS OF IMMIGRANTS TO CANCER
RESEARCH IN AMERICA

BY STUART ANDERSON

EXECUTIVE SUMMARY

More than 40 percent of the cancer researchers at America's top cancer institutes are immigrants. Cancer researchers endure the same long wait for green cards as other highly skilled immigrants and their employers. The lack of reliable ways for American cancer institutes and other employers to retain top talent comes at a time when the United States faces an aging population but also the potential for great medical and technological breakthroughs to save and enhance lives.

Immigrant scientists have played an important role in improving the cancer survival rates experienced by Americans. Examining the immigration background of researchers at America's leading comprehensive cancer centers, including Johns Hopkins, Memorial Sloan-Kettering, the MD Anderson Cancer Center, Fred Hutchinson Cancer Research Center and others, reveals a high percentage of cancer researchers at these facilities are foreign-born. Moreover, biographies and interviews reveal a deep dedication to improving the lives of patients and Americans in general. The findings make a strong case for America liberalizing policies on high skill immigration for individuals in science, technology, engineering and math (STEM) fields, including doctors and foreign-born professionals with degrees in biology and chemistry.

The National Foundation for American Policy examined approximately 1,500 biographies of cancer researchers at the nation's leading cancer research centers (as measured by grants received from the National Cancer Institute). Among the findings:

- Overall, 42 percent of the researchers at the top 7 cancer research centers are foreign-born.
- At the University of Texas MD Anderson Cancer Center 62 percent of the cancer researchers are immigrants. In 2012, *U.S. News & World Report* ranked MD Anderson the number one cancer treatment facility in the country for patients.
- At Memorial Sloan-Kettering Cancer Center in New York, 56 percent of the researchers are foreign-born.
- The significant contributions of immigrants can also be seen at other top cancer research facilities. At Fox Chase Cancer Center in Philadelphia, 44 percent of the cancer researchers are immigrants. At Johns Hopkins Sidney Kimmel Comprehensive Center – 35 percent immigrant researchers; at the Dana-Farber Cancer Institute – 33 percent; University of California San Francisco Helen Diller Family Comprehensive Cancer Center – 32 percent; and the Fred Hutchinson Cancer Research Center – 30 percent.

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- The researchers at the top 7 cancer centers come from more than 50 countries. Among the 56 countries, the leading country of origin for cancer researchers is China, followed, in order, by India, Germany, Canada, the United Kingdom, Italy, Russia, Lebanon, South Korea, France, Japan, Israel, Australia, Greece, Spain, Brazil, Taiwan and Argentina. Researchers from China account for 21 percent of the foreign-born cancer researchers at the 7 centers (and 8 percent of all cancer researchers at the 7 centers). India was the country of origin for 10 percent of the foreign-born researchers, followed by Germany and Canada at 7 percent, and the United Kingdom at 6 percent.
- Four immigrant cancer researchers have won the Nobel Prize: Elizabeth Blackburn (2009), born in Tasmania, Australia, Baruj Benacerraf (1980), born in Italy, and Carl and Gerty Cori (1947), husband and wife researchers born in Austria-Hungary.
- Eleven immigrants have served as president of the American Association for Cancer Research; two immigrants, George H.A. Clowes (UK) and Leo Loeb (Germany), were among the organization's original 11 members, which has now grown to 34,000 members.
- The first head of the National Cancer Institute was an immigrant, Carl Voegtlin. Immigrants lead cancer centers or key departments around the country. An example is Peter Jones, born in South Africa, who was director of the USC Norris Comprehensive Cancer Center.
- Dr. Alfredo Quiñones-Hinojosa is a Professor of Neurosurgery, Oncology, Neuroscience, and Cellular and Molecular Medicine at Johns Hopkins University. He is the director of the Brain Tumor Surgery Program at the Johns Hopkins Bayview Hospital and Director of the Pituitary Surgery Program at the Johns Hopkins Hospital and leads the facility's Brain Tumor Stem Cell Laboratory. He first came to America as an undocumented farm worker knowing little English and he overcame obstacles to graduate from Harvard Medical School and become a leading neurosurgeon. He performs over 250 brain surgeries a year, often removing life-threatening tumors and his work in brain cancer is funded by the National Institutes of Health.
- Dr. Waun Ki Hong, a native of South Korea, is one of the founders of chemoprevention and the leader of the MD Anderson Cancer Center's Division of Cancer Medicine. His research and clinical work on premalignant lesions of the larynx has enabled thousands of patients in the United States to avoid potentially damaging surgery and maintain the ability to speak and swallow.

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At some point, cancer, “a group of diseases characterized by uncontrolled growth and spread of abnormal cells,” touches the lives of everyone in America, since it is likely every American knows (or will know) a friend, relative or co-worker who has contracted cancer. Over 1.6 million new cancer cases occur each year, according to the American Cancer Society. Moreover, more than 577,000 people in the United States die from cancer annually, the second leading cause of death behind heart disease.

Despite these troubling statistics there is also good news as the move toward increased specialization has benefitted Americans. “The 5-year survival rate for all cancers diagnosed between 2001 and 2007 is 67 percent, up from 49 percent in 1975-77,” reports the American Cancer Society. The survival rates have improved for the most common forms of cancer. “The 5-year relative survival rate for female breast cancer patients has improved from 63 percent in the early 1960s to 90 percent today.” Medical research is the primary reason for the improvement in cancer survival rates. Such research leads to new treatments and greater understanding of the body’s responses to different forms of cancer.

Many of the individuals who help combat cancer at America’s top cancer facilities typically work in H-1B status at some point in their careers. In practical terms, that means legislative or regulatory restrictions aimed at H-1B visa holders would likely harm efforts to treat Americans afflicted with cancer. Foreign nationals working in H-1B status while at a cancer research facility typically include physicians, researchers, research technicians, information technology specialists and lab technologists. When sponsoring cancer researchers through the labor certification/green card process, cancer institutes endure the same costs and time as other employers.

If one would poll Americans on which immigrants they would most like to see admitted to the country, it is likely cancer researchers would be at the top of the list. Therefore, it was surprising to officials at research institutes that Congress specifically excluded the fields that would have allowed foreign-born cancer researchers to gain permanent residence (green card) in the United States when the U.S. House Representatives passed H.R. 6429, the STEM Jobs Act last year. The bill did not pass the U.S. Senate and cancer center officials hope this will be corrected in any future legislation.

Previous estimates from the National Foundation for American Policy show wait times today for many employment-based immigrants, particularly those from India and China due to the per country limit, range from 6 years to even decades. The lack of reliable ways for even cancer researchers to obtain permanent residence illustrates how broken the U.S. immigration system has become.

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BACKGROUND: IMMIGRANT SCIENTISTS AND AMERICA'S IMPROVING CANCER SURVIVAL RATES

Immigrant scientists have played a key role in the cancer survival rates experienced by Americans. Examining the immigration background of researchers at America's leading comprehensive cancer centers reveals that a high percentage of cancer researchers at these facilities are foreign-born. Moreover, biographies and interviews reveal a deep dedication to improving the lives of patients and Americans in general.

Table 1
Immigrant Researchers at America's Top Cancer Centers

Cancer Research Center	Percentage of Cancer Researchers Who Are Foreign-Born
University of Texas MD Anderson Cancer Center	62 percent
Memorial Sloan-Kettering Cancer Center	56 percent
Fox Chase Cancer Center	44 percent
Johns Hopkins Sidney Kimmel Comprehensive Cancer Center	35 percent
Dana-Farber Cancer Institute	33 percent
UCSF Helen Diller Family Comprehensive Cancer Center	32 percent
Fred Hutchinson Cancer Research Center	30 percent

Source: National Foundation for American Policy, cancer center websites, direct contact with individual researchers and cancer center staff. Analysis of approximately 1,500 biographies of cancer researchers on staff at the 7 comprehensive cancer centers that received the highest amount of P30 grants from the National Cancer Institute in 2010. Johns Hopkins separates out physician scientists in its staff listings and the physician scientist list was utilized. The list of Members of the UCSF Helen Diller Family Comprehensive Cancer Center was examined. At each center there were some individuals for whom no biographical information at all was available and they were excluded. For individuals with incomplete data that left it unclear whether the person was foreign-born, despite attempts at verification, such individuals were either excluded from the count or by default treated as native-born in an attempt to arrive at conservative estimates of the percentage of foreign-born at the facilities.

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Cancer “is a group of diseases characterized by uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death.”¹ At some point, cancer touches the lives of everyone in America, since it is likely every American knows (or will know) a friend, relative or co-worker who has contracted cancer. Over 1.6 million new cancer cases occur each year, according the American Cancer Society. Moreover, more than 577,000 people in the United States die from cancer annually, the second leading cause of death behind heart disease.

There is also positive news. “The 5-year survival rate for all cancers diagnosed between 2001 and 2007 is 67 percent, up from 49 percent in 1975-77,” reports the American Cancer Society.² The survival rates have improved for the most common forms of cancer. “The 5-year relative survival rate for female breast cancer patients has improved from 63 percent in the early 1960s to 90 percent today.”³ For women diagnosed with “localized breast cancer” the 5-year relative survival rate is 99 percent.⁴

Medical research is the primary reason for the improvement in cancer survival rates. Such research leads to new treatments and greater understanding of the body’s responses to different forms of cancer. Charles S. Fuchs, M.D., an oncologist specializing in gastrointestinal cancer at the Dana-Farber Cancer Institute, notes that when he first started practicing medicine there was only one drug used to combat colon cancer. Today, Fuchs said, there are at least 7 such drugs approved by the Food and Drug Administration.⁵ J. Dirk Iglehart, M.D., a surgical oncologist at Dana-Farber, believes there are “so many more opportunities” for treatments today than there were just 10 years ago for many types of cancers.⁶

COMPREHENSIVE CANCER CENTERS AND FOREIGN-BORN RESEARCHERS

The National Foundation for American Policy examined the biographies of doctors and researchers at America’s leading comprehensive cancer centers and found foreign-born doctors and scientists play an important role in cancer research and treatment in America. Biographical data were examined for approximately 1,500 cancer researchers at the nation’s leading cancer research centers (as measured by grants received from the National Cancer Institute). Overall, 42 percent of the researchers at the top 7 cancer research centers are foreign-born.⁷

¹ Julia Anderson provided valuable research assistance on this paper. Cancer Facts & Figures 2012, American Cancer Society, p. 1.

² Ibid, p. 1.

³ Ibid., p. 11.

⁴ Ibid., p. 10.

⁵ Dr. Charles S. Fuchs, Dana-Farber Cancer Center website.

⁶ Dr. J. Dirk Iglehart, highlighted on Dana-Farber Cancer Center website.

⁷ The 7 comprehensive cancer centers that received the highest amount of P30 grants from the National Cancer Institute in 2010 were the University of Texas MD Anderson Cancer Center, Memorial Sloan-Kettering Cancer Center, Fox Chase Cancer Center, Johns Hopkins Sidney Kimmel Comprehensive Center, Dana-Farber Cancer Institute, University of California San Francisco Helen Diller Family Comprehensive Cancer Center, and the Fred Hutchinson Cancer Research Center. Johns Hopkins separates out physician scientists in its staff listings and the physician scientist list was utilized. The list of Members of the UCSF Helen Diller Family Comprehensive Cancer Center was examined. At each center there were some individuals for

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Comprehensive cancer centers are crucial to advancements in the detection and treatment of cancer in the United States. Such centers are designated by the National Cancer Institute (NCI), which is part of the National Institutes of Health. “An NCI-designated comprehensive cancer center must demonstrate reasonable depth and breadth of research in each of three major areas: laboratory, clinical, and population-based research, as well as substantial transdisciplinary research that bridges these scientific areas.”⁸ Although the National Cancer Institute has designated 67 cancer centers, only 41 are comprehensive cancer centers. On the recommendation of the National Cancer Institute the comprehensive cancer centers chosen for this research were the top recipients of P30 Core Grants from the National Cancer Institute. “NCI-designated cancer centers are at the forefront of NCI-supported efforts at universities and cancer research centers across the United States that are developing and translating scientific knowledge from promising laboratory discoveries into new treatments for cancer patients,” according to the National Cancer Institute.⁹

Table 2
Country of Origin for Cancer Researchers at the 7 Top Cancer Centers in the U.S.

Country of Origin	Percentage Among Foreign-Born
China	21 percent
India	10 percent
Germany	7 percent
Canada	7 percent
United Kingdom	6 percent
Italy	3 percent
Russia	3 percent
Lebanon	2 percent
South Korea	2 percent
France	2 percent
Japan	2 percent

Source: National Foundation for American Policy, cancer center websites, direct contact with individual researchers and cancer center staff. Analysis of approximately 1,500 biographies of cancer researchers on staff at the 7 comprehensive cancer centers that received the highest amount of P30 grants from the National Cancer Institute in 2010.

whom no biographical information at all was available and they were excluded. For individuals with incomplete data that left it unclear whether the person was foreign-born, despite attempts at verification, such individuals were either excluded from the count or by default treated as native-born in an attempt to arrive at conservative estimates of the percentage of foreign-born at the facilities.

⁸ <http://www.cancer.gov/researchandfunding/extramural/cancercenters/about>.

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IMMIGRATION RESTRICTIONS AFFECT CANCER RESEARCHERS AND FACILITIES

Despite the public health importance of battling cancer, inadequate employment-based green card quotas and per country limits harm top-flight cancer researchers just as much as other highly skilled immigrants, according to officials at U.S. cancer research institutes. The problem is worse for researchers from China and India, which are the countries most affected by the per country limits. Past National Foundation for American Policy estimates show wait times ranging from 6 years to even decades for many employment-based immigrants.¹⁰

“These individuals are stuck in holding patterns for an extraordinary amount of time,” said Adam S. Cohen, Assistant General Counsel and Manager, Immigration Services at Memorial Sloan-Kettering Cancer Center in New York. “Even if they receive a National Interest Waiver our physician-researchers could wait several years for permanent residence.”¹¹ A recipient of a National Interest Waiver does not need to endure the costly and time-consuming process of labor certification but still must wait for a green card to be available to attain permanent residence.

Many of the individuals who help combat cancer at America’s top cancer facilities typically work in H-1B status at some point in their careers. In practical terms, that means legislative or regulatory restrictions aimed at H-1B visa holders would likely harm efforts to treat Americans afflicted with cancers. Adam Cohen notes that foreign nationals working in H-1B status during their time at a cancer research facility include physicians, researchers, research technicians, information technology specialists and lab technologists. Under a change in the law in 1998, non-profit research institutions and universities can hire foreign nationals on H-1B visas beyond the annual numerical limitations that cause other employers often to wait many months for a new supply of visas in the following fiscal year. But such institutions must still comply with any current or future regulations that may make it difficult to hire or retain foreign nationals on H-1B status. Crystal Williams, executive director, American

¹⁰ For more information on estimated backlogs and waiting times see *Still Waiting: Green Card Problems Persist for High Skill Immigrants*, NFAP Policy Brief, National Foundation for American Policy, June 2012.

¹¹ Interview with Adam S. Cohen.

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Immigration Lawyers Association, notes that the O-1 visa is only possible to use for “those who are well-established in their fields,” while an H-1B visa holder is needed for someone who shows early promise. “They fall under different standards for qualification,” she said.¹² Cancer institutes endure the same costs and time as other employers when sponsoring a foreign national through the labor certification and green card process.

HOUSE STEM BILL WOULD HAVE EXCLUDED CANCER RESEARCHERS

If one would poll Americans on which immigrants they would most like to see admitted to the country, it is likely cancer researchers would be at the top of the list. Therefore, it was surprising to officials at research institutes that Congress specifically excluded the fields that would have allowed foreign-born cancer researchers to gain permanent residence in the United States when the U.S. House Representatives passed H.R. 6429, the STEM Jobs Act last year.

The bill, which passed the House in November 2012 but failed to move in the Senate, would have provided up to 55,000 additional employment-based green cards to foreign nationals who received a Ph.D. or master’s degree from a U.S. university in a “field of science, technology, engineering, or mathematics (STEM degree),” according to the bill’s summary. But the bill excluded biology, chemistry and medicine from the definition of science, limiting it only to “physical sciences.”¹³

Congressional sources indicate the reason for redefining the word “science” to include only “physical sciences” was the result of anecdotes about some job difficulties experienced by graduates in some science fields. However, a November 2012 joint study by the Information Technology Industry Council, the U.S. Chamber of Commerce, and the Partnership for a New American Economy found the unemployment rates for biological scientists and medical scientists for U.S. citizens were only 2.9 percent and 3.4 percent respectively, well below the unemployment rate for U.S. citizens in non-STEM fields and below what the U.S. government has labeled as full employment (4 percent) for the economy as a whole.¹⁴ More importantly, the study concluded, “There is no evidence that a large concentration of foreign workers in a STEM occupation leads to high unemployment for U.S. workers in that occupation.” Officials at cancer research institutions hope this exclusion of cancer researchers and others in medical-related fields from access to additional green cards will be corrected in future immigration legislation.

¹² Stuart Anderson, *Immigration* (Santa Barbara, CA: Greenwood, 2010), p. 65.

¹³ Section 2 of H.R. 6429. In section 2, the bill stated, “The term ‘field of science, technology, engineering, or mathematics’ means a field included in the Department of Education’s Classification of Instructional Programs taxonomy within the summary groups of computer and information sciences and support services, engineering, mathematics and statistics, and physical sciences.”

¹⁴ *Help Wanted: The Role of Foreign Workers in the Innovation Economy*, Information Technology Industry Council, the U.S. Chamber of Commerce, and the Partnership for a New American Economy, November 2012, pp. 10-11.

MEMORIAL SLOAN-KETTERING CANCER CENTER

Memorial Sloan-Kettering Cancer Center in New York City is a comprehensive cancer center and one of the world's leading facilities for care of cancer patients. "Memorial Sloan-Kettering Cancer Center experts have established standards of care and treatment protocols for each type and stage of cancer," the center notes. "Our physicians have an extraordinary depth and breadth of experience in diagnosing and treating all forms of the disease, from the most common to the very rare. Each year, they treat more than 400 different subtypes of cancer. This level of specialization can have an often-dramatic effect on a patient's chances for a cure or control of their cancer . . . Patients are treated by as many different specialists as are needed for their particular type of disease, including surgeons, medical oncologists, radiation oncologists, radiologists, pathologists, psychiatrists, and nurses."¹⁵

More than half – 56 percent – of appointed faculty at the Gerstner Sloan-Kettering Graduate School of Biomedical



Sciences are foreign-born, according to an analysis of staff biographies at Sloan-Kettering. Among the foreign-born scientists is Michael Kharas. At an early age, he seemed destined for a career in medicine. As a boy growing up in Israel, Michael already knew what he wanted to do with his life. "When I was ten, a friend asked me if I wanted to be a doctor when I grew up. 'No,' I recall saying, 'I want to be making the drugs doctors use to cure people.'"¹⁶

Michael Kharas, Ph.D.

Both of Michael's parents studied chemistry in the former Soviet Union before emigrating to Israel and later the United States. In high school he interned in a lab at DePaul University. In graduate school he worked in the lab of University of California, Irvine professor David Fruman. "A great mentor, David had a cancer-related project running in his lab, and he offered me the opportunity to work on it," said Michael. "Working in David's lab, I had a first glimpse of the immediacy with which some basic science discoveries might be translated into the clinic, and ultimately benefit patients."¹⁷

Today, Michael heads a laboratory in the Molecular Pharmacology and Chemistry Program of the Sloan-Kettering Institute. "My colleagues and I are exploring the mechanism by which Musashi-2 controls the fate of stem cells and tumor cells, and identifying other RNA-binding proteins that have a similar function. Clarifying this process

¹⁵ <http://www.mskcc.org/about>.

¹⁶ "At Work: Cancer Biologist Michael Kharas," Memorial Sloan-Kettering Cancer Center.

¹⁷ Ibid.

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may inform the development of new approaches to treat some cancers and blood disorders — for example, in the context of bone marrow transplantation,” he said. “As in many other areas of biology, research on stem cells is largely a black box. I think we will be busy for a long time prying the box open. What eggs me on is the idea that we might one day be able to extract something useful — a sliver of understanding moving us one step closer to controlling cancer and other diseases.”¹⁸

Immigrants chair two important departments at Sloan-Kettering. Hedvig Hricak, who received a Ph.D. at the Karolinska Institute in Sweden and a medical degree at the University of Zagreb, is the chair of the Department of Radiology. In 2010, she was named president of the Radiological Society of North America Board of Directors. “Dr. Hricak is renowned internationally for her extensive research and clinical expertise in genitourinary and gynecologic imaging. She is a pioneer in the development of modern multimodality techniques for visualizing the structure and function of male and female genitourinary cancers,” according to an announcement of her appointment.¹⁹ She helped develop the MRI and CT for use in gynecologic cancers, as well as using technology for prostate cancer screening.²⁰

Alexander Rudensky, born in the former Soviet Union, chairs the Immunology Program at Sloan-Kettering. “In 1989, just before the fall of the Berlin Wall, I was able to travel to West Berlin and, for the first time, present my work at the International Immunology Congress,” said Alexander. “Excited at finding myself in the midst of an international group of outstanding scientists, hearing about the most recent developments in the field of immunology, I began looking for more exposure to research taking place outside of the Soviet Union.”²¹ With a fourth child on the way and fearing the “political turmoil” in the Soviet Union would end badly, he wrote to a well-respected American immunologist, Charles Janeway. He was “stunned” when Janeway asked him to join his laboratory at the Yale University School of Medicine.”²²

“Much of our research [at Memorial Sloan-Kettering] has lately been focused on a specific population of white blood cells called regulatory T cells, which can repress the immune system's reaction to infections or cancer,” said Alexander. “We've found that these cells are critical for keeping other white blood cells in check; in their absence, the immune system instead of attacking ‘intruders’ — for example, a cell infected with virus or bacteria — strikes against normal cells and tissues, causing monstrous inflammatory responses that can be fatal.”²³ Alexander,

¹⁸ Ibid.

¹⁹ “Hedvig Hricak Named President of Radiological Society,” *Center News Magazine*, Memorial Sloan-Kettering Cancer Center, February 1, 2010.

²⁰ Hedvig Hricak, physician profile, Memorial Sloan-Kettering Cancer Center.

²¹ “At Work: Immunology Program Chair Alexander Rudensky,” Memorial Sloan-Kettering.

²² Ibid.

²³ Ibid.

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along with a fellow immigrant and medical investigator at Sloan-Kettering, Nikola Pavletich, chair of the Structural Biology Program, were named as members of the National Academy of Sciences in 2012.²⁴

JOHNS HOPKINS SIDNEY KIMMEL COMPREHENSIVE CANCER CENTER

The Johns Hopkins Sidney Kimmel Comprehensive Cancer Center in Baltimore, Maryland, is recognized as a leading cancer research and treatment facility. “The work by Center investigators in cancer genetics and epigenetics is recognized as the classic model for deciphering the mechanisms of cancer initiation and progression,” according to the center. “The pioneering research that defined cancer as a genetic disease was done at our center. These discoveries led to the first genetic tests for a hereditary cancer and a screening stool test for colon cancer. Our investigators were the first to map a cancer genome, deciphering the genetic blueprints for colon, breast, pancreatic, and brain cancers. Of the 75 cancers for which all genes have been sequenced, 68 have been done at the Kimmel Cancer Center. These discoveries have paved the way for personalized therapies with our investigators undertaking the first use of personalized genome scanning to reveal the gene mutation that caused a person’s inherited from of pancreatic cancer.”²⁵

Dr. Alfredo Quiñones-Hinojosa

An analysis of staff biographies shows 35 percent of the physician scientists at the Johns Hopkins Sidney Kimmel Comprehensive Cancer Center are immigrants. Among the most well known physicians at Johns Hopkins is Dr. Alfredo Quiñones-Hinojosa, Professor of Neurosurgery and Oncology at Johns Hopkins University and director of the Brain Tumor Surgery Program. He also leads the Brain Stem Tumor Cell Laboratory. Known by many as Dr. Q, his life is so storied it could fill a book. In fact, it has, as the doctor authored his recent autobiography *Becoming Dr. Q*.²⁶

²⁴ “Two Memorial Sloan-Kettering Investigators Named to National Academy of Sciences, *News and Insights from Memorial Sloan-Kettering*, May 30, 2012.

²⁵ “About Our Center,” Johns Hopkins Sidney Kimmel Comprehensive Cancer Center website.

²⁶ Alfredo Quiñones-Hinojosa, *Becoming Dr. Q* (Berkeley, CA: University of California Press), 2012.

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There are more than 100 types of brain cancer and of the approximately 600,000 Americans with brain or nervous system tumors about 124,000 have malignant brain cancers.²⁷ “The research is really the most exciting part of what I do,” said Dr. Quiñones-Hinojosa. “I’m not only trying to save lives in the operating room. The research we are doing with this tissue is to try and find out whether or not there are stem cells within brain cancer – stem cells that are going crazy, stem cells that cannot regulate their own growth, and are therefore killing patients. That’s my research.”²⁸

In the book, Dr. Quiñones-Hinojosa describes as a teenager, at the age of 14, entering the United States on a tourist visa and working illegally over a long summer as a farm worker, managing to bring back to Mexico almost \$1,000, which he believed could feed his family for a year. On a later trip, U.S. Border Patrol Agents caught and returned him to Mexico but he later succeeded in entering the United States and benefitted from the 1986 Immigration Reform and Control Act, signed by President Ronald Reagan, which gave legal status to many undocumented immigrants. With little knowledge of English, he entered community college in San Joaquin, later graduated from the University of California, Berkeley, and earned a degree in medicine from Harvard Medical School.

Along the way, he had at least four close personal brushes with death. He nearly died as a young man when, working as a laborer, he fell into the bottom of a railway fuel tank car and came within minutes of suffocating. While fulfilling his residency at a San Francisco hospital he was pricked by a needle used on an HIV-positive patient and endured a year of testing (and worry) before it could be determined the infection did not pass to him. While in community college, a driver who accused him of cutting him off pointed a gun in his face, threatened to shoot him, and then drove away. And while windsurfing, Alfredo developed a cramp and was unable to swim back to the boat. His date that day was fortunately a lifeguard, his future wife Anna, and she saved him from drowning. Along the way to becoming a neurosurgeon he faced other obstacles, including the belief that perhaps a young man born in Mexico could not possess the intelligence or ability to serve patients in such a demanding field of medicine.

In an interview on C-SPAN, Dr. Quiñones-Hinojosa described why he wrote his book and his feelings about America. “I wanted to tell the story about this underdog, this kid, who came to the United States with nothing and now based on hard work, mentorship, and doors being opened, and opportunities being given, and me taking those opportunities I was able to show the world that you can still fulfill the American Dream and that America is still the most beautiful country in the world.”²⁹

²⁷ Q&A, October 16, 2011. <http://www.q-and-a.org/Transcript/?ProgramID=1361>

²⁸ “Dr. Alfredo Quiñones-Hinojosa,” Evelyn & Walter Haas Jr. Fund.

²⁹ Q&A, October 16, 2011. <http://www.q-and-a.org/Transcript/?ProgramID=1361>.

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While his rise from farm worker to brain surgeon is a great personal achievement, Dr. Quiñones-Hinojosa gives credit to mentors like Harvard faculty members Dr. Ed Kravitz and Dr. David Potter, who both gave him \$500 when, while in medical school at Harvard, nearly all his family's possessions were stolen from his apartment. Dr. Potter told him, "You'll do for others what others have done for you. I have no doubt."³⁰ Dr. Q continues to do for others, constantly meeting students all over the U.S. who may or may not have the same opportunities he has had and encouraging them to never give up their dreams, performing 250 brain surgeries a year on patients – over 2,000 surgeries in his career – and leading a laboratory that he hopes one day will unlock the mysteries of cancer and its cure.

FRED HUTCHINSON CANCER RESEARCH CENTER



The Fred Hutchinson Cancer Research Center in Seattle, Washington, focuses on "important breakthroughs in the prevention, early detection and treatment of cancer." The center reports, "Our scientists study the disease process from every angle – from the most basic, molecular and cellular level to a broad, population-based approach – to uncover the factors that influence a person's likelihood of getting cancer, and using this knowledge to reduce risk and save lives . . . Our world-class scientists, including three Nobel Laureates, have revolutionized prevention, early detection treatment and cures, and survivorship."³¹

Dr. Chu Chen

An analysis of staff biographies finds 30 percent of the cancer researchers at Fred Hutchinson are immigrants. According to the Human Resources department, the Fred Hutchinson Cancer Research Center utilizes 6 different types of employment visas, most of which are for more than 200 visa holders working as postdoctoral fellows. "Other job categories with visa holders include statistical research associates, staff scientists, systems analyst/programmers, and research technicians," according to the center. Overall, staff members are from more than 50 countries around the world. "We provide extensive visa-related immigration support since our ability to employ the best and brightest from around the world is essential to our success," said a center spokesperson. "The Hutchinson Center also offers administrative assistance to those who are trying to obtain their permanent residency, though some of our faculty members come to us having already obtained their green card while at another institution."³²

³⁰ *Becoming Dr. Q*, p. 153.

³¹ "Research Overview," Fred Hutchinson Cancer Research Center website.

³² Information and statements provided by Kristen Lidke Woodward, Senior Media Relations Manager, Fred Hutchinson Cancer Research Center.

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Doctors in the United States diagnosed over 36,000 new cases of oral cancer in 2010, with nearly 8,000 people dying from the disease each year.³³ Dr. Chu Chen, who was born in China and raised in Taiwan, played a key role in a recent potential breakthrough in treating oral cancer. “For the first time, Hutchinson Center scientists have identified genes that signal when oral cancer has spread to lymph nodes in the neck,” according to the Fred Hutchinson Cancer Research Center. “If confirmed by additional research, the discovery of this four-gene set could lead to the development of a biomarker-based test of the tumor that could help physicians determine whether oral squamous cell carcinoma has spread and therefore become more deadly.”³⁴

The findings first appeared in an April 2011 issues of *Clinical Cancer Research*. “Currently, doctors use tumor size as an indicator of potential cancer spread and remove the cervical lymph nodes of all patients whose tumors are larger than two centimeters. However, metastasis occurs in only 20 percent to 40 percent of such patients, meaning that 60 percent to 80 percent of the surgeries are unnecessary,” according to Dean Forbes of the Fred Hutchinson Cancer Research Center.³⁵ “The advantage of this gene signature, when applied to patients at risk for metastasis to neck lymph nodes, is that we’d maintain our ability to detect lymphatic metastasis while reducing the number of false positives and thus the number of unnecessary surgeries,” said Dr. Chu Chen, who is a molecular epidemiologist in the Public Health Sciences Division of Fred Hutchinson.³⁶

Dr. Rainer Storb, head of the Transplantation Biology Program and one of the founders of the Fred Hutchinson Cancer Research Center, was born in Germany and came to Seattle in the 1960s on a Fulbright Fellowship. He stayed in America, became a U.S. citizen, and helped create Seattle’s marrow transplantation program. “One practical example of his work translated from preclinical studies into the . . . novel use of combination drug therapy to prevent graft-versus-host disease, which occurs when donor bone marrow reacts against the patient after transplantation,” according to the Gabrielle’s Angel Foundation for Cancer Research. “Dr. Storb’s formulated drug schedule is now the ‘gold standard’ in use at centers worldwide. His work applied to patients with aplastic anemia has defined and improved treatments and increased the long-term survival of this patient group to greater than 90 percent.”³⁷

According to ScienceWatch, Storb has been the 10th most cited physician-scientist and the 43rd most cited scientist overall worldwide, including the second most-quoted researcher in the field of oncology.³⁸ When Storb first started in the transplant field doctors generally didn’t offer them to patients over 40 because of the fear they

³³ Dean Forbes, “Researchers identify genes that signal oral cancer spread,” *Center News*, Fred Hutchinson Cancer Research Center, May 9, 2011.

³⁴ Ibid.

³⁵ Ibid.

³⁶ Ibid.

³⁷ Rainer Storb, M.D., profile, Medical Advisory Board, Gabrielle’s Angel Foundation for Cancer Research.

³⁸ Information received from Fred Hutchinson Cancer Research Center.

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couldn't survive them. "Starting in the mid-1990s, Storb developed what came to be called a mini-transplant because he drastically reduced levels of chemotherapy and radiation; eradication of cancer was accomplished through the action of immune cells from the donor graft. In many cases, patients are not hospitalized when undergoing the procedure. Patients as old as 78 have received the treatment."³⁹

Another German immigrant who has made significant contributions to the treatment of American cancer patients is Dr. Ulrike Peters, an assistant member of the Public Health Sciences Division at Fred Hutchinson. She is leading or co-leading programs in the Genetics and Epidemiology of Colorectal Cancer Consortium (GECCO) and the Colorectal Transdisciplinary (CORECT) Study, Population Architecture using Genomics and Epidemiology (PAGE), and the National Heart, Lung, and Blood Institute's (NHLBI) Grand Opportunity Exome Sequencing Project (GO-ESP). "Within well characterized and diverse study populations, she is studying the impact of common and rare genetic variants across the entire genome, as well as interactions between genetic variants and environmental factors (such as diet, exercise, smoking and aspirin use)," according to the Fred Hutchinson Cancer Research Center.⁴⁰ Two of her current lab personnel received degrees in the United States and the center sponsored their H-1B petitions.⁴¹

Two immigrants from Australia at Fred Hutchinson are helping patients, including children, combat cancer. Immunologist Marie Bleakley focuses her work addressing graft-vs.-host disease, which is "a painful, life-threatening immune response" that can take place in children and adults treated for leukemia. Marie came to the Hutchinson Center in 2002 as a medical fellow in 2002, worked on an H-1B visa, and was sponsored for her employment-based green card by the center, becoming a permanent resident in 2008.⁴²

According to the Fred Hutchinson Cancer Research Center, "Marie Bleakley's research could fundamentally alter the standard approach to blood stem-cell transplantation. Bleakley, an assistant member of the Clinical Research Division at Fred Hutchinson and a pediatric oncologist at Seattle Cancer Care Alliance, is attempting to design a transplant regimen that maximizes the treatment's cancer-curing potential while minimizing complications like graft-vs.-host disease (GVHD) and infections that can take hold before the patient's new immune system has had time to reach full strength (a process known as immune reconstitution)."⁴³ The hope is for more effective treatment. "Through bone marrow and stem-cell transplantation, we're able to successfully treat many of these young patients with the most severe forms of leukemia," Bleakley said. "Unfortunately for some, transplantation can lead to graft-vs-host disease, and in other patients leukemia can recur after transplantation." She hopes

³⁹ Rainer Storb, Featured Researchers, Fred Hutchinson Cancer Research Center.

⁴⁰ Ulrike Peters, Fred Hutchinson Cancer Research Center.

⁴¹ Fred Hutchinson Cancer Research Center.

⁴² Ibid.

⁴³ Ibid.

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additional research “will help us learn how to reduce the occurrence and severity of graft-vs.-host and reduce the occurrence of leukemic relapse, which will improve the success of transplantation and ultimately save lives.”⁴⁴

Dr. Cameron Turtle, also from Australia, has already made an impact in his young career. He started at the Hutchinson Center on a J-1 visa in 2005 as a postdoctoral research fellow. “The Hutchinson Center marked a clinical milestone recently when immunologist Dr. Cameron Turtle, an assistant member of the Clinical Research Division, treated his first patient with highly specialized T-cells genetically engineered to target a molecule called CD19,” according to the center. “It is the first clinical trial in which central memory T-cells are purified and then genetically engineered to target cancer cells. Central memory T cells are the rare immune cells that Turtle and colleague Dr. Stanley Riddell discovered could serve as a long-lasting source of cancer-fighting T-cells . . . Turtle expects to treat 30 leukemia and lymphoma patients over the coming years with this novel and promising approach. He also is studying immunologic approaches to breast cancer treatment. Turtle grew up and attended medical school in Sydney.”⁴⁵

THE UNIVERSITY OF TEXAS MD ANDERSON CANCER CENTER

With 62 percent of its cancer researchers foreign-born, the University of Texas MD Anderson Cancer Center has the highest share of immigrant researchers among the cancer centers examined in this analysis. *U.S. News & World Report* ranked the MD Anderson Cancer Center number one in cancer care for 2012-13, the “6th year in a row and 9th time in the past 11 years.”⁴⁶ The center, located in Houston, Texas, serves over 100,000 patients a year, including 10,000 registrants in clinical trials. That is the largest clinical trials program in the United States to explore new treatments, according to the center.

Perhaps MD Anderson’s most distinguished researcher is Dr. Waun Ki Hong, a native of South Korea who earned his medical degree in Seoul, Korea. He has been appointed to the National Cancer Advisory Board and received the lifetime honor of an American Cancer Society Clinical Research Professorship.⁴⁷ He became chief of the Head and Neck Medical Oncology Section in 1984, and later the leader of the MD Anderson’s Division of Cancer Medicine (in 2001). “Dr. Hong



Dr. Waun Ki Hong

⁴⁴ Christi Ball Loso, “Immunologist wins \$250,000 Hyundai Grant for Pediatric Oncology Research, *Center News*, Fred Hutchinson Cancer Research Center, September 24, 2012.

⁴⁵ *Ibid.*

⁴⁶ “About Us,” MD Anderson Cancer Center.

⁴⁷ “President George W. Bush Names Waun Ki Hong, M.D., to National Cancer Advisory Board,” M. D. Anderson News Release, June 12, 2008.

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is one of the founders of cancer chemoprevention and pioneered a new paradigm for cancer – the possibility that it can be prevented or delayed,” according to the MD Anderson center. “His landmark studies demonstrating that high-dose retinoic acid can reverse oral premalignant lesions and prevent the development of second primary tumors were the first to prove that chemoprevention can work in humans.”⁴⁸

His research and clinical practice have helped thousands of cancer patients maintain the ability to speak and swallow by avoiding certain surgical methods. “He has demonstrated proof of principle for bio-chemoprevention in reversing advanced premalignant lesions of the larynx, using a combination of interferon, retinoids, and vitamin E. This novel approach shows great promise for reversing advanced premalignancies and for prevention of primary tumors in high-risk cohorts such as former smokers. Dr. Hong showed for the first time that genetic damage to the airways can persist for many years after smoking cessation and developed ways to identify genetically former smokers at highest risk for lung cancer.”⁴⁹

FOX CHASE CANCER CENTER

In 1974, the National Cancer Institute designated Fox Chase one of the first comprehensive cancer centers. Located in Philadelphia and now part of Temple Health, Fox Chase devotes much of its resources to cancers that disproportionately affect women. However, it is designed to address all types of adult cancers.

Forty-four percent of the cancer researchers at Fox Chase Cancer Center are immigrants, according to an analysis of staff biographies. The director of The Breast Cancer Research Laboratory at Fox Chase is Dr. Jose Russo, who has authored over 350 publications and has trained 50 Ph.D. and M.D. investigators related to cancer research.⁵⁰ As the director of the Breast Cancer Research Laboratory, Russo is overseeing more than a dozen ongoing research projects. Both Dr. Russo and his wife Dr. Irma Russo were born in Argentina.

UCSF HELEN DILLER FAMILY COMPREHENSIVE CANCER CENTER

The University of California, San Francisco Helen Diller Family Comprehensive Cancer Center started in 1948 under the name the UCSF Cancer Research Institute. “The overarching goal of the Cancer Center is to shepherd new approaches to cancer prevention, detection, and treatment into clinical and population settings, where they can be tested and evaluated,” according to the center.⁵¹ Like other institutions examined in this report, UCSF’s accomplishments and research discoveries would take up a number of pages but they include developing a new class of chemotherapy drugs “designed to reduce toxicity and increase effectiveness,” a laboratory technique for

⁴⁸ Dr. Waun Ki Hong, profile, MD Anderson Cancer Center.

⁴⁹ Ibid.

⁵⁰ Jose Russo, M.D., Fox Chase Cancer Center.

⁵¹ “History and Overview,” University of California, San Francisco Helen Diller Family Comprehensive Cancer Center website.

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“detecting and analyzing genetic abnormalities in cancer cells,” and improving “treatment guidelines for early-stage prostate cancer.”⁵²

Immigrants make up 32 percent of the cancer researchers at the UCSF Helen Diller Family Comprehensive Cancer Center, based on an analysis of staff biographies. The most famous immigrant at UCSF is Elizabeth Blackburn, born in Tasmania, Australia, who shared the 2009 Nobel Prize for Medicine with Jack Szostak (Harvard Medical School), a British-born immigrant to the U.S., and American-born Carol Greider (Johns Hopkins University School of Medicine). Greider was Elizabeth Blackburn’s student in 1985 when they “published a paper announcing the discovery of the enzyme telomerase.”⁵³



Dr. Elizabeth Blackburn

Dr. Blackburn and Dr. Szostak were able to establish that “repeated DNA sequences make up the tips of each chromosome.”⁵⁴ Since the enzyme serves an important function in the health of cells, the discovery has helped launched research into cancer, cardiovascular disease and other age-related illnesses.⁵⁵ In naming Elizabeth Blackburn “Scientist of the Year” in 2007, *Discover Magazine* wrote, “Imagine that this scientist kept a to-do list: On it would be a cure for cancer and, further down, understanding the diseases associated with aging. Elizabeth Blackburn is the 59-year-old Tasmanian-born scientist responsible for launching one of the hottest fields in the life sciences, the study of telomeres. These tiny strips of DNA cap the ends of chromosomes, and her research promises to yield potent therapeutics for many of the scourges that plague humanity.”⁵⁶

She has hoped the discovery of telomeres will yield new treatments for cancer. “We’re working with animal hosts where we put human cancers in and we try to attack the telomerase. In one published study where we put melanoma cells into mice, we published it with mouse melanoma cells, but we repeated it with human cells . . . Just lowering it, not even killing it off, was enough to make these cells less metastatic. So that’s pretty good

⁵² “Accomplishments and Research Discoveries,” UCSF website Helen Diller Family Comprehensive Cancer Center website.

⁵³ Goutam Naik, “U.S. Cell-Aging Researchers Awarded Nobel,” *The Wall Street Journal*, October 6, 2009, A5.

⁵⁴ *Ibid.*

⁵⁵ *Ibid.* See also Stuart Anderson, *Immigration* (Greenwood, 2010).

⁵⁶ Linda Marsa, “Scientist of the Year Notable: Elizabeth Blackburn,” *Discover Magazine*, December 6, 2007.

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because metastasis is what kills you in cancer, not the primary tumor. If you can get anything that lessens the metastasis, that's good."⁵⁷

Dr. Adil Daud was born in India, where he earned his medical degree, and is the director of the Melanoma Clinical Research at UCSF's Helen Diller Family Comprehensive Cancer Center, where he treats patients and conducts research. "I think you develop a more intense kind of relationship with cancer patients than with other kinds of patients," said Daud. "That's something that attracted me." He recalls a patient with melanoma that had spread to the brain and lungs. "Chemotherapy saved the man's life and appears to have left him cancer-free," according to Daud. The patient asked, "Do you think I can consider marriage?" Daud told him: "Why not?" Six years after that conversation, Daud said he remains inspired by a wedding photo of the patient and yearly Christmas cards.⁵⁸

DANA-FARBER CANCER INSTITUTE

Founded in 1947 by Dr. Sidney Farber, the Dana-Farber Cancer Institute is a founding member of the Dana-Farber/Harvard Cancer Center, which is a NCI-designated comprehensive cancer center, and a founding member of the Center for AIDS Research at Harvard University. In 2011, Dana-Farber's outpatient clinics registered more than 350,000 appointments and infusions, and provided patients with access to nearly 700 clinical trials. The institute has notable achievements in cancer research and treatment. In the 1990s, Dana-Farber scientists discovered a group of genes related to an inherited form of colon cancer. In 2008, "Dana-Farber scientists achieved a medical first: using a 'targeted' drug to drive a patient's metastatic melanoma into remission."⁵⁹

Overall, 33 percent of the cancer researchers at the Dana-Farber Cancer Institute are immigrants. Among the foreign-born scientists playing an important role in research at Dana-Farber are Robert I. Haddad and Paul G. Richardson. Robert I. Haddad, M.D is an Associate Professor of Medicine at Harvard Medical School and the Disease Center Leader of the Head and Neck Oncology Program at Dana-Farber. Dr. Haddad "earned his medical degree from St. Joseph's University France Faculty of Medicine in Beirut, Lebanon."⁶⁰ He has authored more than 100 medical articles, reviews and book chapters on head and neck cancer.⁶¹ As the clinical director of the Head and Neck Cancer Treatment Center at Dana-Farber, Haddad is responsible for helping to decide on the proper combination of radiation and chemotherapy when treating patients with head and neck cancers. "We are able to cure 80 to 85 percent of the patients right now," he said. "We would like to bring that to 100 percent."⁶²

⁵⁷ Ibid.

⁵⁸ <http://cancer.ucsf.edu/heroes/adil-daud.1564>

⁵⁹ "Advances in Patient Care and Research at Dana-Farber," Dana-Farber Cancer Institute website.

⁶⁰ Robert I. Haddad, Dana-Farber Cancer Institute website.

⁶¹ Ibid.

⁶² Robert I. Haddad, M.D. video interview, Dana-Farber Cancer Institute website.

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Paul G. Richardson, M.D. is the Clinical Director of The Dana-Farber Cancer Institute's Jerome Lipper Center for Multiple Myeloma. (Myeloma is a cancer that affects plasma cells, which are white blood cells.) Dr. Richardson attended medical school at the University of London, St. Bartholomew's Medical College and completed residencies in internal medicine at Newcastle General and Freeman Hospitals, and Royal Marsden Hospital, London, as well as Beth Israel Deaconess Medical Center.

"Currently, I am leading multiple efforts studying the use of combination therapies predominantly in relapsed and refractory myeloma, an area of primary interest to me," said Dr. Richardson. "I also serve as a principal investigator and study chairman for several clinical trials relating to other areas of myeloma treatment, including the use of combination therapies in earlier disease designed to target resistance and reduce toxicity. My major leadership efforts are focused . . . in patients eligible for stem cell transplant in combination with RVD [Revlimid-Velcade-Dexamethasone]. Finally, an important new area of interest for me is treatment-emergent neuropathy in myeloma, its characterization and strategies to minimize it."⁶³

UNC LINEBERGER COMPREHENSIVE CANCER CENTER

The UNC Lineberger Comprehensive Cancer Center is staffed by 40 or more departments at the University of North Carolina at Chapel Hill. The N.C. Cancer Hospital, clinical home of UNC Lineberger, is where patients receive their oncology care. "With funding from external grants and the state-supported University Cancer Research Fund, UNC Lineberger faculty treat cancer patients, conduct research into the causes of cancer and search for new treatments, develop and direct statewide programs in cancer prevention, and train future physicians, nurses, scientists and public health professionals," according to the center.⁶⁴

Among the immigrant cancer researchers at Lineberger is UNC Professor and virology specialist Dirk Dittmer, born in Germany, who helps lead the center's global efforts and certain clinical trials. One recent trial explains that "20- 25% of human cancers are infection associated. Our cancer-related efforts seek to combine translational studies on Kaposi sarcoma and viral lymphoma with genetically engineered mouse models and the detailed molecular investigation of key viral oncogenes, including micro RNAs . . . Secondly, we are actively engaged in the search for new cancer-associated viruses, for instance in cancers that are frequent in low and medium income countries as part of global oncology efforts."⁶⁵

Another prominent immigrant researcher at UNC Lineberger is Yue Xiong, who has been "recognized for distinguished contributions to the field of cancer research, particularly for the study of cell cycle control, ubiquitin pathway and metabolic regulation in cancer development" by the American Association for the Advancement of

⁶³ Paul G. Richardson, M.D., physician profile, Dana-Farber Cancer Institute website.

⁶⁴ "About UNC Lineberger," UNC Lineberger Comprehensive Cancer Center website.

⁶⁵ Dirk Dittmer, profile, UNC Lineberger Comprehensive Cancer Center.

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Science.⁶⁶ He was brought to the U.S. through the China-United States Biochemistry Examination and Application (CUSBEA) program in 1984. Chinese-born Ray Wu, a professor at Cornell University who made significant contributions to DNA sequencing in the United States, is credited with helping found the program. Many of the scientists who have participated in the U.S.-China program have taught at U.S. universities or become cancer researchers in the U.S.⁶⁷ Xiong was recently involved in a cancer research program at his alma mater, Fudan University in Shanghai to help train a new generation of Chinese scientists.

USC NORRIS COMPREHENSIVE CANCER CENTER

The USC Norris Comprehensive Cancer Center in Los Angeles, California, was one of the first 8 institutions in the United States to receive the designation “comprehensive cancer center.” The center draws its 200-plus scientists and physicians from the Keck School of Medicine of the University of Southern California and other USC departments.⁶⁸ The majority of its program leadership is foreign-born, including the head or co-head of Tumor Microenvironment (Yves DeClerck and Martin Kast), Cancer Epidemiology (Graham Casey and Duncan Thomas), Developmental Therapeutics (David Quinn), Genitourinary Cancers (Gerhard Coetzee and Jacek Pinski) and Gastrointestinal Cancers (Heinz-Josef Lenz).

Peter Jones, born in South Africa, served as director of the USC Norris Comprehensive Cancer Center from 1993, until stepping down recently to focus on his research. “He is known for his studies on the molecular biology of cancer and of basic mechanisms of DNA methylation and its role in cancer and differentiation,” according to the USC Norris Comprehensive Center. “In 1980, Dr. Jones made a seminal discovery that the drug 5-azacytidine could induce profound changes in gene expression at the same time as being a powerful inhibitor of DNA methylation. This discovery was the first to causally link DNA cytosine methylation, differentiation, and gene expression and played a large part in opening the now burgeoning field of epigenetics. The discovery of the mechanism of action of this drug led directly to the isolation of the first mammalian determination gene and also to the discovery of a large number of tumor suppressor genes which become epigenetically silenced in human cancer . . . In addition to this work, Dr. Jones’ laboratory has played a seminal role in the delineation of molecular pathways leading to human bladder cancer, to the realization that DNA methylation sites are hotspots for cancer causing mutations and to the growing realization that epigenetic silencing plays a major role in human carcinogenesis. Dr. Jones’ work has been recognized as a ‘milestone’ in gene expression and a ‘milestone’ in cancer by *Nature* magazine.”

⁶⁶ Mary Ruth, “Six UNC Faculty Recognized by Prestigious International Scientific Society,” UNC Lineberger Comprehensive Cancer Center, December 15, 2011.

⁶⁷ Zhegyi Chang, “The CUSBEA Program: Twenty Years After,” *IUBMB Life*, 61(6): 555-565, June 2009.

⁶⁸ “About USC Norris,” USC Norris Comprehensive Cancer Center website.

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Table 3
Notable Immigrant Cancer Researchers: Past and Present

Immigrant	Place of Birth	Contribution to Cancer Research and Medicine
Baruj Benacerraf	Venezuela	Earned Nobel Prize (1980) for “discoveries concerning genetically determined structures on the cell surface that regulate immunological reactions,” led Sidney Farber Institute
Elizabeth Blackburn	Australia	Earned Nobel Prize in Physiology or Medicine (2009) “for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase”
George H.A. Clowes	United Kingdom	Introduced first chemotherapy, an original founder of American Assoc. for Cancer Research
Carl Cori	Austria-Hungary	Earned Nobel Prize (1947) with wife Gerty Cori for “their discovery of the course of the catalytic conversion of glycogen”
Gerty Cori	Austria-Hungary	First woman to earn Nobel Prize (1947), shared with husband Carl
Tom Curran	United Kingdom	Past President of American Assoc. for Cancer Research; he “pioneered laboratory studies of a novel molecule called HhAntag to treat brain cancer without the need for traditional chemotherapy or radiation”
Emmanuel Farber	Canada	Past President American Assoc. for Cancer Research; pioneer in liver cancer research, toxicology and chemical carcinogenesis
Peter Jones	South Africa	Former Director of USC Norris Comprehensive Cancer Center, noted researcher in field of epigenetics
Waun Ki Hong	South Korea	Considered one of the founders of cancer chemoprevention; key researcher at MD Anderson; past Pres., American Assoc. for Cancer Research
Leo Loeb	Germany	In 1907 helped establish mammary cancer was hereditary; pioneer in examining link between cancer and reproductive hormones; an original founder (and past President) of American Assoc. for Cancer Research
Frank McCormick	United Kingdom	A leader in the development of “targeted cancer therapies”; President of American Assoc. for Cancer Research
Enrico Mihich	Italy	Made notable advances in chemotherapy and in the understanding of host-defense mechanisms; past President of American Assoc. for Cancer Research
Andrew Schally	Poland	Earned Nobel Prize (1977) for “discoveries concerning the peptide hormone production of the brain”
Carl Voegtlin	Switzerland	First head of the National Cancer Institute (1938-1943); past President, American Assoc. for Cancer Research

Source: American Association for Cancer Research; National Foundation for American Policy.

CONCLUSION

The finding that immigrants constitute 42 percent of the cancer researchers at America's top cancer institutes makes a strong case for liberalizing policies on high skill immigration for individuals in science, technology, engineering and math (STEM) fields, including doctors and foreign-born with degrees in biology and chemistry.

Contemporary contributions by immigrant cancer researchers are part of a story that has lasted for more than a century. (See Table 3.) George H.A. Clowes, born in the United Kingdom, introduced the first chemotherapy treatment, while Leo Loeb, born in Germany, helped establish that mammary cancer was hereditary. In 1907, immigrants Loeb and Clowes were two of the 11 founding members of the American Association for Cancer Research.⁶⁹ Today, the American Association for Cancer Research has 34,000 members.

When Baruj Benacerraf came to the United States after his family left France in 1939, he was rejected by 10 medical schools because at the time such schools maintained quotas against Jewish and foreign applicants (and he happened to be both). Benacerraf, who was born in Venezuela, eventually was admitted to the University of Virginia. He became a U.S. citizen and served as a doctor in the U.S. Army after World War II. He conducted research, publishing more than 600 papers in his career, and is credited with leading the Sidney Farber Institute, later called the Dana-Farber Cancer Institute, out of "administrative turmoil" when he took over in 1980. He is credited with turning the institute from a "small, largely pediatric . . . research-oriented institution into a comprehensive cancer center." That same year he was awarded the Nobel Prize in Physiology or Medicine for "his work on how the human body distinguishes its own cells from foreign bodies."⁷⁰

Today, increasing the number of green cards for highly skilled immigrants, such as cancer researchers, remains a key policy reform. This would dramatically reduce wait times and encourage more highly skilled individuals to make their careers in America. But other reforms would also help advance cancer research, note those in the field. "I have noticed that our postdocs who are coming here to find a cure and contribute enormously to our research by finding new discoveries, teaching our graduate students and living here in the U.S. (paying taxes) cannot apply to federal postdoctoral fellowships to support the work we are doing," said Dr. Quiñones-Hinojosa of Johns Hopkins. "I find it unfair and maybe one day we can change this."⁷¹

⁶⁹ Appreciation to Kathleen Case, archivist, American Association for Cancer Research for invaluable assistance with the history of cancer research.

⁷⁰ Neena Satija and Mark Feeney, "Baruj Benacerraf, 90; shared 1980 Nobel Prize," *The Boston Globe*, August 3, 2011. He shared the Nobel Prize in 1980 with George Snell and Jean Dausset.

⁷¹ Interview with Dr. Quiñones-Hinojosa.

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If one were to poll Americans on which immigrants they would most like to see enter the United States, undoubtedly cancer researchers would be at the top of the list. The difficulty American cancer institutes and other employers have in retaining top talent comes at a time when the United States faces an aging population but also the potential for great medical and technological breakthroughs to save and enhance lives. Despite the public health importance of battling cancer, inadequate employment-based green card quotas and per country limits harm top-flight cancer researchers just as much as other highly skilled immigrants. The lack of reliable ways for even cancer researchers to obtain permanent residence illustrates how broken the U.S. immigration system has become.

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