

Indiana's Health and Life Sciences Talent and Workforce: Developing Strategies to Compete in a Global Economy

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The background of the page is a solid blue color with a repeating pattern of white line-art icons representing various pieces of laboratory glassware. These icons include Erlenmeyer flasks, round-bottom flasks, test tubes, and beakers, some containing liquid and bubbles. The pattern is dense and covers the entire page.

Prologue

Prologue

In Indiana, one in every ten jobs is found in healthcare delivery or life sciences. With substantial assets spanning corporate, university, and philanthropic sectors, Indiana is a Tier I state in terms of concentration of life sciences employment along with California, Massachusetts, North Carolina and New Jersey. Since 2002, BioCrossroads has tracked the economic impact of life sciences on the state seeking to understand trends and market dynamics. As the most research and development-intensive sector of our economy, the growth of health and life sciences depends upon talent. Highly concentrated in STEM-driven occupations, many careers in life sciences require additional skills, education and training unique to a regulated industry from research and development to production and operations. Changes in healthcare delivery, including the move to more coordinated care and the treatment of increasingly complex cases, drives up educational requirements and specialization. All results in distinctive challenges in developing, attracting and retaining talent to support growth.

But will the demand for high-skilled talent continue to grow and will we be able to meet these needs? In August 2015, in conjunction with Battelle's Technology Partnership Practice, we released a report reviewing the impact of talent on innovation—an important driver of growth. Here we are taking a deeper look at the projected job growth in healthcare delivery and life sciences—across all skill levels—as well as the expected available workforce in order to begin to identify imbalances as well as corrective actions.

Battelle's Technology Partnership Practice, the premier experts in analyzing and charting the development of America's life sciences (which transitioned to the independent organization, TEconomy Partners, LLC mid-way through this effort) augmented secondary data from the Bureau of Labor Statics, Indiana's Department of Workforce Development, and other data sources with industry employer surveys of Indiana's health and life sciences companies, interviews with life sciences stakeholders, and focus groups. This helped to better understand expected growth in demand of health and life sciences jobs as well as the projected available talent pool. In addition, TEconomy compared these findings with other benchmark states with significant employment specialization in life sciences subsectors including California, Illinois, Massachusetts, Minnesota, Missouri, North Carolina and Utah. Areas of imbalance between supply and expected demand for talent were identified and recommendations for proposed approaches across four strategic priority areas were provided. Throughout this process, TEconomy worked with the staff at BioCrossroads and shared preliminary findings with an Advisory Committee and focus groups assembled for the purposes of this

study. These surveys, interviews and guidance from the Committee and focus groups, together with knowledge gained from programs in other states, form the basis of this report.

The health and life sciences industry in Indiana has grown over 22 percent in employment since 2001 and, according to the Indiana Department of Workforce Development, is expected to continue to generate 12,000 job openings in key occupational groups annually. It accounts for one in ten private sector jobs across all skills levels and has higher average wages in almost every occupational group. However, the health and life sciences sector has challenges meeting these demands as pending retirements pose a broad concern across production, nursing and scientific jobs; changing demands in healthcare delivery cause a refinement in the occupational mix necessary to deliver healthcare; rising use of information technology demands increased data sciences skills; and national competition only intensifies for higher skilled health and life sciences occupations. Indiana's universities have highly regarded STEM programs in engineering, biological sciences, and information technology attracting students from across the country and around the world. In fact, Indiana ranks 11th among all states in the number of out-of-state undergraduate students in its four-year public institutions with Indiana University ranking third among all public institutions in the country with more than 2,000 out-of-state undergraduate students and Purdue with the third highest number of first-year foreign undergraduate students. And while jobs in health and life sciences often require advanced degrees as well as job experience, the report finds that the mix of in-state vs. out-of-state graduates from Indiana's colleges and universities provides an early indicator of the pipeline available for talent. While we retain more than half of all health profession graduates (60 percent in-state; 10 percent out-of-state), our retention rates for engineering, biological science, and computer and information sciences graduates are all significantly lower with only 33-49 percent of in-state student graduates and only 5-6 percent of out-of-state student graduates working in Indiana.

Our life sciences industry is strong and growing, and we have extensive opportunities for our talent. Yet, imbalances remain. In order to address this dynamic, four broad strategic priorities have been identified including ensuring a strong foundation of STEM skills to prepare for post-secondary education and life-long learning; promoting strong connections to career opportunities in health and life sciences; upgrading the skills of our incumbent health and life sciences workforce; and raising our ability to attract and retain top talent. There are many groups working together to develop, upgrade, retain and attract talent to continue to support the growth of healthcare delivery and life sciences. These efforts require an ongoing and vigorous effort from Indiana stakeholders in public-private partnerships involving the State, our universities, industry, and our philanthropic community. These strategic programs are long-term and are showing impact, but many additional opportunities for improvement remain. The growth of our health and life sciences sector depends on our continued successful efforts to do just that.

This is an important and timely report. And certainly, it is appropriate here to thank those whose efforts have made it possible: the Lilly Endowment, through a generous grant to the CICP Foundation on behalf of BioCrossroads, that provided the essential funding; the many members of the health

and life sciences community who participated in surveys and interviews; and our colleagues now at TEconomy, who know both Indiana and the life sciences sector well, and have drawn on their substantial expertise to provide a helpful and comprehensive study.

Sincerely,

A handwritten signature in black ink, appearing to read "David L. Johnson". The signature is fluid and cursive, with the first name "David" being the most prominent.

David L. Johnson
President and CEO, BioCrossroads
May 2016

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Executive Summary

Executive Summary

Talent, specifically the availability and quality of talent, is becoming a critical competitive factor in today's innovation-driven economy. Further, the competitive bar is constantly rising with the fast pace of technological change and the higher level of global competition in talent posed by both developed and developing economies. Looking to the future, many jobs that lie on the lower-skilled end of the spectrum are expected to be automated, math and computer skills are increasingly emphasized among those in middle-skilled jobs, and employers want a high-skilled workforce that is more multidisciplinary and cross-functional.

Of great concern is whether the U.S. can keep pace with the educational and skill needs of the 21st century. Forecasts developed by the Georgetown University Center on Education and the Workforce project steady demand and rapid growth for science, technology, engineering and math (STEM)-related occupations, with expected national employment growth of 17 percent by 2018, compared with just 10 percent projected growth among all jobs¹. In addition to filling new jobs, demand for STEM-related talent will be compounded by job openings created by the retirement of the baby-boom generation. Georgetown projects 2.4 million total job vacancies in STEM occupations between 2008 and 2018, but it is not clear that the U.S. education system is measuring up to this growing demand. U.S. students at all levels—elementary, middle, and high school—are outperformed by many of their foreign counterparts in international assessments of science and math achievement. The implications of lagging student achievement carry forward from their roots in elementary and middle schools through high schools and ultimately result in relatively few U.S. students pursuing bachelor's and graduate degrees in STEM-related fields. Less than one-third of bachelor's degrees earned in the U.S. are in science and engineering fields compared with significantly higher rates in other nations, including China.

For the health and life sciences industry, which stands as the most research and development-intensive sector of our economy, the importance of talent is well recognized—and the challenges are particularly acute. Nationally, the industrial life sciences employ a workforce of more than 50 percent in jobs that require at least a bachelor's degree involving a wide range of occupations in research and development, production, quality and regulatory functions. In healthcare delivery, increasingly complex cases, technologies, and operating environments drive steady demand for high-skilled professionals and are driving up educational requirements for large segments of the workforce. It is therefore not surprising that the health and life sciences industry poses its own talent challenges in requirements for specialized knowledge in biological systems and health needs along with a diversity of skills to meet

¹A.P. Carnevale, Nicole Smith, Michelle Melton, "STEM: Science, Technology, Engineering, Mathematics," Georgetown University Center on Education and the Workforce, October 2011. STEM-related occupations in the study include computer occupations; mathematical science occupations; architects, surveyors, and technicians; engineers and engineering technicians; and life and physical science occupations.

a wide range of industry activities involving research and development, regulatory affairs, advanced production under high quality control requirements, and healthcare delivery. PricewaterhouseCoopers (PwC) found from extensive interviews with life sciences executives in 2012 that 51 percent, the largest share among the 19 industries interviewed, reported hiring to be more difficult than before, with just 28 percent expressing confidence they would have access to needed talent².

While the challenges of talent in the health and life sciences are widely shared across states, how they play out within a particular state can vary significantly. Each state has its own mix of health and life sciences industries, presenting not only a different mix of industry specializations, but different core technology competencies. At the same time, the population dynamics and generation of talent by local educational institutions vary widely across states.

This study seeks to provide a comprehensive understanding of the health and life sciences talent dynamics taking place in Indiana to ensure the state has a robust talent base to meet the needs of the state's health and life sciences industry to remain a globally competitive, economic driver for Indiana. Past studies of overall talent needs in Indiana have revealed that the competitive requirements for talent in the state's health and life sciences sector stand out from other Indiana industries. The 2012 Central Indiana Corporate Partnership (CICP) study on *Indiana's Competitive Economic Advantage: The Opportunity to Win the Global Competition for College Educated Talent* found the life sciences industry in Indiana as likely having a higher level of high-skilled workforce than the nation, led by its biopharmaceutical sector³. At the time of the study, information technology (IT) jobs seemed to be outstripping the supply of talent and the sector was seen to be a bright spot in an otherwise dismal picture. Major industry groupings, such as advanced manufacturing, distribution, financial and insurance, stood below the U.S. levels of deployed high-skilled talent. The growth in demand for life sciences workforce was not fully highlighted. In fact, this above-national level of industry demand for high-skilled jobs within the sector set the life sciences apart from other industry sectors in the state.

The overall objective of this study is as follows:

Develop a fact-based understanding of the demand and supply of life sciences workers in Indiana, and the factors shaping how demand and supply can be more closely linked.

More specifically, this project assesses the need, requirements, and approaches for developing talent and workforce generation, retention, and attraction strategies for Indiana in the life sciences by addressing the following key questions:

- What workers with which skills will be needed by the life sciences industry?
- What talent supply and capacity does Indiana have now?
- What are the major gaps?
- What should Indiana do?

² "PwC 15th Annual Global CEO Survey," 2012.

³ This higher level of industry deployment of high-skilled talent for the life sciences is based on the higher average wages paid to life sciences jobs in Indiana than the nation. A direct measurement of high-skilled workers employed in the life sciences industry was not possible due to confidential disclosure restrictions by the U.S. Department of Labor if there is a high concentration of life sciences employment in just a few companies, as is the case in Indiana, with employers such as Eli Lilly and Company.

KEY FINDINGS

It is no surprise that a detailed assessment of the demand and supply for health and life sciences talent finds that the growing health and life sciences industry in Indiana is generating significant high-quality job opportunities across a range of skill levels.

- **The health and life sciences industry in Indiana is vibrant and a major economic driver for the state**, recording significant job growth of over 22 percent in health and life sciences employment since 2001 and continued, though slower job growth since the economic recovery took hold in 2009. The full industry now accounts for more than 265,000 jobs as of 2014, or just over 1 in every 10 jobs in the state.

- **These job gains in Indiana are ranging broadly across skill levels and demonstrating the diverse job opportunities afforded by the growth of health and life sciences industries.** Across health and life sciences occupations, Indiana has made gains since 2010 in 10 out of 11 major health and life sciences occupations, with seven of these occupational groups enjoying double-digit growth from 2010 to 2014. This growth in health and life sciences occupations in Indiana ranges across lower-skilled production to middle-skilled technicians and allied health workers to high-skilled scientists, engineers, and health diagnosing and treating jobs.

- **Across the mix of skill levels, the jobs being created in health and life sciences occupations are high quality, offering Hoosiers a decent and rising standard of living.** Reflecting the fact that the health and life sciences industry is among our nation's highest value and most innovation-driven industry sectors, the jobs being created in health and life sciences occupations

The Health and Life Sciences Industry Defined

In this study the industry includes:
The *Industrial Life Sciences* spanning:

- Biopharmaceuticals
- Medical Devices
- Agbiosciences

And *Health Services* which includes hospitals, outpatient centers, medical and diagnostic labs, home healthcare services, and nursing and residential care facilities.

The industry in Indiana represents:

- **1 in 10 Private Sector Jobs** across all skill levels
- **22% growth** in industry employment since 2001
- **High Average Wages** exceeding the overall economy in nearly every key occupational group

offer higher and faster-growing wages than the average for the overall economy in Indiana in nearly every case, even for much of the lower- and middle-skilled health and life sciences occupations. The average wages of Indiana's combined health and life sciences occupational groups—taking together all of the industrial life sciences and healthcare delivery occupations—are above the overall average wages in Indiana. Even more impressive is that the growth in average wages for all major health and life sciences occupations exceeds the average growth in wages for all industry jobs in Indiana.

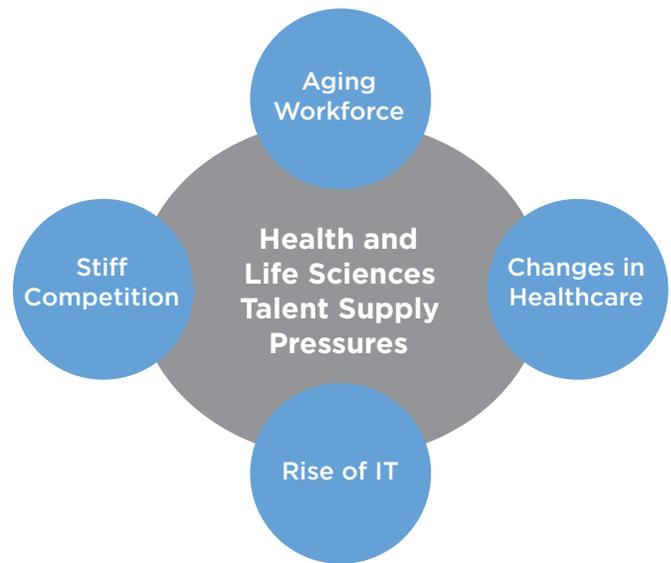
What is particularly impressive in Indiana's recent generation of health and life sciences occupations is the strong growth in high-skilled jobs that play a critical role in raising Indiana's capacity to innovate and to stay globally competitive. Not only are high-skilled health and life sciences occupations growing in Indiana, they are outpacing the growth found nationally. For scientists and engineers employed in the health and life sciences industry, the growth in Indiana has been robust, growing 53 percent and 34 percent respectively from 2010 to 2014, which is more than double the national growth rates for each occupation. Similarly, life sciences managers and healthcare diagnosing and treating occupations grew more than 10 percent over the 2010–2014 period, slightly more than the national average. While it takes a mix of skills to meet the workforce needs of a growing health and life sciences industry, this strong growth in highly skilled health and life sciences jobs in Indiana signals a continued commitment to innovation and product development in Indiana that is critical for a globally competitive industry.

Looking to the future, the demand for health and life sciences jobs seems bright. In the next two years, the survey of health and life sciences employers in Indiana completed for this study finds existing vacancies and expected hiring to generate 15 percent growth in overall health and life sciences jobs. Among the fastest growth will be in jobs such as clinical trials coordinators, medical/clinical lab technicians, research technicians, engineers, manufacturing and production, and marketing and sales. Looking longer term, the Indiana Department of Workforce Development projects that through 2022, the level of job openings in health and life sciences will reach over 12,000 annually, not including broader skill needs for IT and manufacturing production workers that health and life sciences industries share with other industries in Indiana. Among the 25 fastest-growing occupations in Indiana, health and life sciences jobs are well represented as these occupations include registered nurses, licensed practical nurses, medical services managers, pharmacists, and family physicians, as well as mechanical engineers, industrial engineers, and computer systems analysts.

So there is much to celebrate around the recent job gains in health and life sciences occupations. Still, Indiana cannot afford to be complacent. While demand is strong and continues to grow, significant challenges lie ahead for Indiana's capacity to meet the needs of industry for health and life sciences workers.

- **An aging workforce is a looming issue for health and life sciences talent.** All types of health and life sciences occupations appear to face the aging of the workforce. The challenge is not

just about finding replacement workers, but also about finding the best ways to sustain the knowledge and expertise gained over the years that will be lost with increased retirements. Pending retirements pose a broad concern across production, nursing, and even scientific jobs found within the health and life sciences industry.



- **Changing demands in healthcare delivery.** **There is a major shift in the business model of healthcare underway that is already placing new skill demands on the healthcare workforce.** Healthcare is shifting to a more value-driven model requiring a focus on delivering measurably better, quality outcomes for patients for reimbursement. This new business model for healthcare is creating an increased focus on team-based healthcare delivery models that is refining the occupational mix needed to deliver healthcare to patients and creating needs for new skills within healthcare occupations, such as more team-based working, project management, and communications skills. Newer health occupations are also in demand to offer more flexible delivery of healthcare services to meet the new business model focused on healthcare outcomes, such as physician assistants and nurse practitioners.
- **Rise of IT across health and life sciences.** The unprecedented massive datasets being generated from modern biological research on humans and plants, patient medical records, increased utilization of advanced imaging and molecular diagnostics, and the rise of remote monitoring in healthcare delivery and agriculture are all transforming health and life sciences into an information-dominated business. For instance, McKinsey heralds a coming era of “connected health” that will feature more data-based transparency of health innovation and healthcare delivery to focus on the right treatment for the right patient at the right time.⁴ The ability of health and life sciences to make use of information technology and the analysis of the large datasets being generated is becoming a competitive issue, requiring increased availability and quality of IT and data science skills in the health and life sciences workforce.
- **Stiff competition from other leading health and life sciences states is raising the bar as Indiana competes for talent.** Compared with other leading states in health and life sciences, Indiana is in the middle of the pack in its growth, concentration, and average wage levels across all health and life sciences occupations, though wage gains have been stronger in Indiana than among other leading states. Many of the higher-skilled health and life sciences occupations—such as

² Sam Marwaha, et al., “Biopharma in the coming era of ‘connected health’,” McKinsey on Business Technology, Spring 2012.

scientists and engineers—represent national labor markets, where Indiana must compete for talent, and even homegrown top talent from Indiana’s universities.

The results suggest significant imbalances in the alignment of supply and demand that pose challenges across eight of the major health and life sciences occupational groups. These eight major occupational groups facing imbalances reflect the strength of Indiana in generating “high demand,” but are significantly impacted by a combination of issues, such as the aging of the workforce, significant attrition among college graduates leaving the state, indications of too few graduates, or challenges with sourcing qualified individuals locally or across the state.

Perhaps the most broad-based talent need across the health and life sciences in Indiana is in IT skills. Both industrial life sciences and healthcare services businesses surveyed raised the importance of meeting the fast-rising demand for IT skills both as its own growing occupational group involved in health and life sciences and as an increasingly demanded skill within existing occupations. The focus on IT also is found across a range of skill levels, from a need for lower- and middle-skilled workers to help operate data systems and input medical records to requirements for more high-skilled workers capable of software development and undertaking the analysis, often requiring specialized bioinformatic skills, of large datasets.

Meeting this need for IT skills is a competitive concern based on our benchmarking to other leading health and life sciences states. IT is the one area of workforce where Indiana is especially lagging, with Indiana’s growth and concentration of workforce in IT jobs being well behind the record of other leading health and life sciences states.

A CALL TO ACTION FOR INDIANA

For Indiana to address its talent dynamics in health and life sciences, four broad strategic priorities need to be pursued across the talent pipeline:

- **Ensuring a strong foundation of STEM skills to prepare for postsecondary education and the lifelong learning required for careers in health and life sciences occupations.**
- **Fostering postsecondary talent generation in Indiana that promotes strong connections to career opportunities in health and life sciences.**
- **Upgrading the skills of Indiana’s incumbent health and life sciences workforce** to meet the changing skill demands of the fast-paced innovations and changing business models transforming the health and life sciences industry.
- **Raising Indiana’s ability to attract and to retain top health and life sciences talent** across the highly competitive national labor markets for scientific, engineering, and medical talent.



Below is a brief review of Indiana’s strategic needs in each of these priority areas based on the data analysis, employer survey results, and guidance from the Advisory Committee assembled to guide this report.

Ensuring a Strong Foundation of K-12 STEM Skills

New talent generation is very much about the future of Indiana and the commitment of the state to the economic prosperity for future generations. The starting point for new talent generation is having a strong foundation at the K-12 educational level. Still, K-12 is generally not an end in itself since eligibility for most of the jobs in health and life sciences requires additional postsecondary education. So, to be successful in new talent generation, states need a fully integrated approach across K-12 STEM and postsecondary education that features career awareness of health and life sciences occupations, educational requirements at the K-12 level, and proactive articulation toward postsecondary degrees and credentials in health and life sciences fields.

Given the major needs around both K-12 STEM and postsecondary education in advancing new talent generation, the industry-led Advisory Committee called for each to have its own strategic priority that focuses on the integration across these two highly interrelated educational areas.

The challenges to K-12 STEM education in Indiana are critical. The data on Indiana's K-12 STEM education performance show middling performance with little to no improvement in national assessments in science and math against their peers from other states. Indiana's 8th graders score right near the national average scores in both subjects, ranking 18th in mathematics in 2013 and 27th in science in 2011, the latest data available from the National Assessment of Educational Progress (NAEP). From its position in 2005, Indiana moved ahead in state rankings one spot in math and dropped three positions in science.

Areas of concern raised by industry and postsecondary education leaders that relate to K-12 STEM readiness and career awareness include the following:

- Need for statewide STEM efforts to begin much earlier, with a foundation in elementary grades, to address the subsequent fall-off in student interest and performance in math in high school.
- A general lack of student awareness of career opportunities in the health and life sciences industry by K-12 students; this has translated into recruitment challenges for Indiana's postsecondary institutions, particularly the community colleges, in life sciences disciplines and applied programs.
- Importance of emphasizing teacher professional development as well as student learning.

The surveys and interviews with health and life sciences industry executives did point to one area where a more direct connection between K-12 education and health and life sciences jobs is possible, namely for the production workforce. There are opportunities for some production jobs for high school students proficient in math and technology skills who also have soft skills needed at the workplace (no drug use, on-time work arrival, ability to work in teams, good communication skills,

etc.). Such students often can directly qualify for production work with only some on-the-job training needed.

Fostering Postsecondary Health and Life Sciences Talent Generation in Indiana

Closer to the near-term needs of employers for new talent generation are the efforts underway at the postsecondary level to educate the future workforce in skill sets from science to engineering to IT to health fields that are in demand by Indiana's health and life sciences. Overall, Indiana's colleges and universities are viewed as a valuable resource and held in high regard by health and life sciences industry executives.

The data on graduates confirm that Indiana's colleges and universities are generating a significant number of graduates across a broad mix of degree fields aligned with the major health and life sciences degrees. Still, there are concerns about whether the level of talent being generated and retained in Indiana is sufficient.

- **For many healthcare occupations, the demand for new workers is outstripping the sizable number of graduates being generated in Indiana.** A critical challenge is meeting the high demand for nursing across the diverse range of practice areas and healthcare settings in which they work. Not only is the demand for nursing extremely high, with nursing being the #1 occupation identified in Indiana for job openings by the Indiana Department of Workforce Development, but also the skill sets required are rising.
- **For other health and life sciences occupations, when the total number of degrees generated each year is adjusted for Indiana's retention of graduates for employment in the state, Indiana falls far short, particularly for engineering and IT graduates.** An increase in the numbers of in-state students pursuing degrees in engineering and IT areas relating to health and life sciences occupations would go a long way toward addressing this imbalance.

Upgrading the Skills of Indiana's Incumbent Health and Life Sciences Workforce

Existing workforce skills are critical. Today's existing workforce represents the vast majority of available workers in Indiana over the next 3 to 5 years since it takes time to generate new talent. The fast pace of technological changes taking place in health and life sciences requires continual skill upgrading for Indiana's existing workforce to stay competitive.

The survey of health and life sciences companies identified many areas of need for both technical skill upgrading and broader employability skill upgrading to meet a changing workplace. These include the following:

- Informatics-related skill upgrading for health and life sciences, including bioinformatic standards and concepts and electronic medical records.

- Clinical trials management skill upgrading to set up and conduct clinical trials involving a wide range of specialized activities, including protocol development, IRB approvals, patient recruitment, regulatory compliance, and privacy requirements.
- Understanding how insurance reimbursement is working under the Affordable Care Act and the broader shift toward value-based health outcomes. This is an emerging need for both healthcare organizations and industrial life sciences companies bringing new products to the marketplace.
- Understanding U.S. Food and Drug Administration (FDA) regulatory approval processes for new products and FDA standards for Good Manufacturing Practices.
- Improving interpersonal and soft skills among their workforce in light of a changing workplace. The areas employers cited most often for “soft” skills upgrading of existing workforce include the following:
 - Understanding how to manage and lead millennials
 - Managing and leading/adapting through change
 - Savvy with digital and social media
 - Government affairs/advocacy
 - Media skills/public speaking skills
 - Business, interpersonal, and communication skills
 - Solution/consultative selling
 - Project management
 - Critical and strategic thinking
 - Financial management acumen.

Raising Indiana’s Ability to Attract and Retain Top Health and Life Sciences Talent

Perhaps the most difficult challenge facing Indiana and any state with a robust economic driver in the health and life sciences industry is the recruitment of top talent. Stated bluntly, top talent drives innovation that is critical to a growing and competitive health and life sciences industry. The market for top talent positions in the health and life sciences is a national one. This sets top talent positions apart from the more local job market involving low- and middle-skilled jobs, where local residents tend to fill most positions.

There are concerns that Indiana is not well positioned for attracting top talent. According to health and life sciences industry executives:

- Indiana is simply not well recognized as a place for top talent careers, even among recent college graduates, due to the lower levels of all advanced industry utilization of high-skilled talent and the relatively weak innovation ecosystem for new ventures.

- Further complicating the recruitment of top life sciences talent is the make-up of much of Indiana’s life sciences industry among large, dominant firms across each subsector, a position envied by many other states and regions, but one that also can translate into top talent not seeing broader opportunities to make Indiana a good location for lifelong careers. In this “big company” setting, career pathways often appear to be far narrower and more linked to individual companies rather than to a broad industry cluster.
- The following are among the most difficult top talent challenges facing health and life sciences:
 - Experienced scientists and executives;
 - Scientists with technical and business savvy, “multidimensional”;
 - Mechanical engineers, especially with exposure to production; and
 - Broad and increasing demand for “IT workers.”
- An aging of the life sciences workforce that affects not only the production side, but also the base of top scientific life sciences talent is another concern.

Still, Indiana does generate a significant level of top talent across its high-quality university base that can go a long way toward addressing the needs of the health and life sciences industry.

But, the level of retention for key science, engineering, and information technology graduates is quite low, even among in-state residents. Among graduates from 2009 to 2013 across Indiana’s public colleges and universities:

- Only 33 percent of in-state biological science graduates (and 6 percent of out-of-state graduates) work in Indiana;
- Only 38 percent of in-state engineering graduates (and 6 percent of out-of-state graduates) work in Indiana; and
- Only 49 percent of in-state computer and information sciences graduates (and 5 percent of out-of-state graduates) work in Indiana.

By comparison, in the healthcare degree fields, more than 60 percent of in-state graduates, and nearly 10 percent of out-of-state graduates, work in Indiana.

Aggressive efforts to retain talent must be a priority for Indiana.

WHAT SHOULD INDIANA DO?

This broad strategic approach recognizes that, while individual education and workforce initiatives are important pieces of the puzzle, there is not a silver bullet that can address the broad-based needs for talent confronting health and life sciences occupations. What is important is an approach that engages all stakeholders in public-private partnerships that build capacity and can be scaled up for success.

Moreover, Indiana has an active base of ongoing efforts that can serve as building blocks for future actions. These efforts, augmented and updated due to changing conditions and economics, must be continued over the long-term. Talent will remain the critical driver for innovation and for the Indiana economy for the foreseeable future. Continuing to focus on developing, retaining, and attracting talent will require effort from Indiana stakeholders in public-private partnerships. Fortunately, Indiana has a long tradition of succeeding in this way; the growth of the life sciences sector depends on it. Table ES-1 summarizes the ongoing activities and proposed approaches for future policies and programs across each strategic priority. For a full discussion of the recommendations, please refer to the section that begins on page 85 of this report.

Table ES-1: Summary of Ongoing Activities and Proposed Approaches for Future Policies and Programs across Four Strategic Priority Areas

STRATEGIC PRIORITY AREA: ENSURING A STRONG FOUNDATION OF K-12 STEM SKILLS
<i>The Building Blocks for Future Actions: Indiana's Ongoing Efforts</i>
Student and Professional In-School STEM Development <ul style="list-style-type: none"> • I-STEM Resource Network • Project Lead the Way • Advanced Placement Training and Incentive Program for Indiana (AP TIP-IN) • Warsaw, Indiana STEM initiatives • Purdue Polytechnic High School (in development)
STEM-related Out-of-School Development <ul style="list-style-type: none"> • Indiana Afterschool Network (IAN)
STEM Teacher Recruitment <ul style="list-style-type: none"> • STEM Teacher Recruitment Fund
STEM Mentoring Program <ul style="list-style-type: none"> • Million Women Mentors

STRATEGIC PRIORITY AREA: ENSURING A STRONG FOUNDATION OF K-12 STEM SKILLS

Addressing Indiana's Unmet Strategic Needs: Drawing on National Best Practices and Industry Insights

- A renewed and comprehensive call to action and dedication of resources for STEM education by the State of Indiana
- Increasing the outreach to diverse student populations to engage them more fully in STEM education
- Better linking STEM education to awareness of health and life sciences careers
- Leveraging place-based customized training

STRATEGIC PRIORITY AREA: FOSTERING POSTSECONDARY HEALTH AND LIFE SCIENCES TALENT GENERATION IN INDIANA

The Building Blocks for Future Actions: Indiana's Ongoing Efforts

Life Sciences Career Awareness

- Orthoworx value-chain mapping to reach out to Indiana's academic institutions on the disciplines and skills required to meet the needs of the state's orthopedic industry and to inform future collaborations

Specialized, Applied Life Sciences Degree Programs

- Grace College Medical Device Quality Management/Regulatory and Clinical Affairs Certification (ORCA)
- Ivy Tech Community College Orthopedic Quality Standards and Technical Skills Certification
- Ivy Tech Community College-Bloomington Biotechnology Program
- Indiana University Bioinformatics Programs
- Engineering schools in Indiana, such as Purdue and Rose-Hulman, are making efforts to grow their bio-medical engineering programs at both the undergraduate and graduate levels

Nursing Education and Training Partnerships

- Community Health Nursing Academy at Ball State University
- Marian University for St. Vincent Health Accelerated Nursing Program

Addressing Indiana's Unmet Strategic Needs: Drawing on National Best Practices and Industry Insights

- Scaling up school-to-career transitions
- Advancing opportunities for targeted courses, certificates, and career-focused degrees for life sciences
- For healthcare professionals, beyond new educational program activities at the postsecondary level, there is a need for public policies to make sure nursing specialists and physician assistants are working at the "top of their license"
- Improving alignment of engineering student design projects, cooperatives, internships, and other experiential learning and professional opportunities with the life sciences

STRATEGIC PRIORITY AREA: UPGRADING THE SKILLS OF INDIANA'S INCUMBENT HEALTH AND LIFE SCIENCES WORKFORCE

The Building Blocks for Future Actions: Indiana's Ongoing Efforts

Continuing Education Programs with Industry Partners

- Grace College Medical Device Quality Management
- Grace College ORCA
- Accelerated nursing programs

Addressing Indiana's Unmet Strategic Needs: Drawing on National Best Practices and Industry Insights

- Establishing a statewide initiative that connects colleges and universities to address the technical and soft skill requirements of advancing technologies and changing workplaces
- Creating incentives and funding mechanisms for industry to place a priority on existing workforce skill upgrading

STRATEGIC PRIORITY AREA: RAISING INDIANA'S ABILITY TO ATTRACT AND RETAIN TOP HEALTH AND LIFE SCIENCES TALENT

The Building Blocks for Future Actions: Indiana's Ongoing Efforts

Connecting Students to Careers

- Initiative to promote opportunities through educational collaborations to connect college talent to industry in Indiana
- Indiana INTERNnet
- The Orr Fellowship

Expanding Research, Education, and Career Opportunities for Top Talent

- Indiana Biosciences Research Institute and 16 Tech Innovation Center
- Marian University College of Osteopathic Medicine—attracting additional faculty and students

Addressing Indiana's Unmet Strategic Needs: Drawing on National Best Practices and Industry Insights

- Establishing incentives for attracting high-skilled life sciences innovation talent to Indiana to raise the state's visibility
- Creating translational life sciences research connections for Indiana graduate student scientists and engineers with Indiana clinicians
- Focusing on place-making activities to attract and retain talent

The background of the page is a solid blue color with a repeating pattern of white line-art icons representing various pieces of laboratory glassware. These icons include Erlenmeyer flasks, round-bottom flasks, test tubes, and beakers, some containing liquid and bubbles. The pattern is dense and covers the entire page.

Report

Introduction

In today’s innovation-driven economy, where businesses need to keep up with the fast pace of technological change, the ultimate competitive factor for economic growth is talent.

Industry executives consistently emphasize that their ability to operate effectively in a global economy with ever-increasing competition depends upon the quality and availability of a wide range of skills across the workforce. As the National Governors’ Association points out in a recent series on State Leadership in the Global Economy: “CEOs report that the availability of technically trained talent is their top priority—one that often determines where they locate high-value investments.”¹

Talent is essential to all stages in the generation and deployment of innovation by industry, representing the following:

- The world-class researchers who drive new discoveries;
- The applied scientists and engineers who help develop new products and processes;
- The entrepreneurs, marketing and finance staff, and business consultants who drive the business side of commercialization and new venture formation that bring innovation to the global marketplace; and
- The technical skills of the workforce to produce and deliver quality products and services.

For the health and life sciences industry, the importance of talent is well recognized. Nationally, the industrial life sciences employ more than 50 percent of its workforce in jobs that require at least a bachelor’s degree involving a wide range of occupations involved in research and development (R&D), production, quality, and regulatory functions. In healthcare delivery, increasingly complex cases, technologies, and operating environments drive steady demand for high-skilled professionals and are driving up educational requirements for large segments of the workforce. In Indiana, the 2012 Central Indiana Corporate Partnership (CICP) study on Indiana’s Competitive Economic Advantage: The Opportunity to Win the Global Competition for College Educated Talent found that life sciences stood out as likely having a higher level of high-skilled workforce than the nation². At the time of the study, information technology jobs seemed to be outstripping the supply of talent and the sector was

¹National Governors’ Association, *State Leadership in the Global Economy*, 2002.

²This higher level of industry deployment of high-skilled talent for the life sciences is based on the higher average wages paid to life sciences jobs in Indiana than the nation. A direct measurement of high-skilled workers employed in the life sciences industry was not possible due to confidential disclosure restrictions by the U.S. Department of Labor if there is a high concentration of life sciences employment in just a few companies, as is the case in Indiana, with employers such as Eli Lilly and Company.

seen to be a bright spot in an otherwise dismal picture. Major industry groupings, such as advanced manufacturing, distribution, financial and insurance, stood below the U.S. levels of deployed high-skilled talent. The growth in demand for life sciences workforce was not fully highlighted, in part, due to confidential disclosure restrictions by the U.S. Department of Labor. In fact, this above-national level of industry demand for high skilled jobs within the sector set the life sciences apart from other industry sectors in the state.

Growing U.S. Talent Challenge is Acute for Health and Life Sciences Industries

Across the U.S., there are significant concerns about the ability to keep pace with the educational and skill needs of our innovation economy. Forecasts developed by the Georgetown University Center on Education and the Workforce project steady demand and rapid growth for science, technology, engineering, and math (STEM)-related occupations, with expected national employment growth of 17 percent by 2018, compared with just 10 percent growth among all jobs.³ In addition to filling new jobs created, demand for STEM-related talent will be compounded by job openings created by the retirement of the baby-boom generation. Georgetown projects 2.4 million total job vacancies in STEM occupations between 2008 and 2018. But, it is not clear that the U.S. education system is measuring up to this growing demand. U.S. students at all levels—elementary, middle, and high school—are outperformed by many of their foreign counterparts in international assessments of science and math achievement. The implications of lagging student achievement carry forward from their roots in elementary and middle schools through high schools and ultimately result in relatively few U.S. students pursuing bachelor’s and graduate degrees in STEM-related fields. Less than one-third of bachelor’s degrees earned in the U.S. are in science and engineering fields, compared with significantly higher rates in other nations, including China.

Top industry executives consistently identify talent challenges as a threat to U.S. competitiveness:

- The 2014 Technology Councils of North America (TECNA) survey completed by over 1,500 C-level (C meaning “chief”) technology executives from member technology councils rated the highest factor that could slow business activity being talent shortage/labor prices/employee turnover. Both tech talent quality and availability were rated as significant or moderate shortages by 74 percent and 76 percent, respectively, of these C-level executives for their states and regions.⁴
- A 2008 survey of Fortune 1000 executives shows growing concern that a shortage of talent threatens U.S. competitiveness—almost all of the executives (95 percent) are concerned that the U.S. is in danger of losing its global leadership position because of a shortage of STEM talent.⁵

³A.P. Carnevale, Nicole Smith, Michelle Melton, “STEM: Science, Technology, Engineering, Mathematics,” Georgetown University Center on Education and the Workforce, October 2011. STEM-related occupations in the study include computer occupations; mathematical science occupations; architects, surveyors, and technicians; engineers and engineering technicians; and life and physical science occupations.

⁴Technology Councils of North America, “National Survey of Technology, Policy and Strategic Issues,” December 2014—see <http://www.tecna.org/national-survey.html#sthash.p7rmEjH5.dpbs>

⁵Bayer Corporation, “Bayer Facts of Science Education Survey XIII,” 2008.

For the health and life sciences industry, which stands as the most R&D-intensive sector of our economy, this concern about the quality and availability of talent is particularly acute—due to the specialized knowledge needed, the mix of industries and business activities undertaken, and the diversity of skills required to meet industry needs.

- **Specialized knowledge needed in the health and life sciences industry:** What makes the life sciences industry sector stand out is its application of a unique and growing body of knowledge on how humans, plants, and animals function. What marks the 21st century is the relentless pace at which science and technology continue to advance and push the boundaries of opportunity to improve lives through medical discovery. Advances in medical discovery are reshaping how we develop new medicines, diagnose diseases, and treat illnesses. We are now able to apply an advanced understanding of biological processes at the molecular and genetic levels to target the development of new therapies, utilize new tools for screening and designing of new medicines, and diagnosis diseases earlier and better match treatments to patients using molecular-based diagnostics. These same advances in biological sciences are also impacting agricultural and food production and helping to create stronger connections between sciences and the crops we grow and how we process these crops into healthier food products.
- **Broad mix of industries and business activities in the health and life sciences industry:** Not only are the specific industries involved in health and life sciences diverse, ranging from biopharmaceuticals to medical devices to agbiosciences to healthcare services, but the activities taking place within these industries are quite extensive given their dependence upon innovation and the adoption of new technologies in their products, processes, and services to patients and customers. Across research, new product development, advanced manufacturing, and the delivery of services one finds the use of fast-changing technologies and products, all within the context of unique regulatory and quality control standards given its impact on human lives whether it is a medicine or food.
- **Diversity of occupations and skills required by the health and life sciences industry:** The specific occupations needed by health and life sciences industry employers reflect the diversity of the industries and their activities, ranging across scientific research, clinical research, engineering, production, distribution/supply chain, and healthcare delivery. Combined with the specialized knowledge and regulatory context, the actual skills required by the health and life sciences industry are unique. These skills start with having to keep pace with advances in molecular biology that involves not only conducting R&D, but also operating specialized instrumentation and interpreting biological data generated. In addition, the translation of biological knowledge to advancing health treatments requires specific regulatory oversight, rigorous clinical trials, and ongoing quality assurance unique to the life sciences industry sector. Increasingly, the value of biomedical applications is converging with digital innovations involved in Big Data, Internet of Things (remote monitoring and diagnosing), and social media, which is

likely to reshape, if not revolutionize, healthcare delivery, patient-physician interactions, and the movement toward more personalized healthcare.

It is no surprise that health and life sciences executives are raising concerns about talent.

PricewaterhouseCoopers (PwC) found from extensive interviews with life sciences executives in 2012 that 51 percent, the largest share among the 19 industries they interviewed, report hiring is now more difficult than before, with just 28 percent expressing confidence they will have access to top talent⁶. Across states the importance of talent issues is also becoming a major focus of attention. For instance, one of the first steps undertaken by the \$1 billion Massachusetts Life Sciences Center initiative after its formation, was undertaking a detailed study on *Growing Talent: Meeting the Evolving Needs of the Massachusetts Life Sciences Industry*. This study brought to light the unique workforce needs of the life sciences industry in identifying critical workforce shortages in specific talent needs areas of the life sciences, including clinical trials management, regulatory affairs, process development and manufacturing engineers, chemistry, pharmacology and toxicology, quality assurance, and laboratory animal care⁷. Similarly, Utah, as part of its overall 2012 life sciences cluster acceleration strategy, placed a special emphasis on workforce trends and skill requirements facing its life sciences industry. This included an in-depth employer survey, which found that the areas in which positions were most difficult to find qualified candidates were regulatory affairs, quality assurance, clinical trials coordination, engineering-process development, and health bioinformatics.

While the challenges of talent in the health and life sciences are widely shared across states, how they play out within a particular state can vary significantly. Each state has its own mix of health and life sciences industries, with not only a different mix of industry specializations, but also different core technology competencies. At the same time, the population dynamics and generation of talent by local educational institutions vary widely across states.

Ensuring a Robust Talent Base for Indiana's Health and Life Sciences Industry to be Globally Competitive

The purpose of this study is to ensure that Indiana has a robust talent base to meet the needs of the state's health and life sciences industry and that this industry remains a globally competitive, economic driver for Indiana. To meet the near-term and long-term needs of the health and life sciences industry for talent, Indiana must be comprehensive in its approach. This means not only addressing the longer-term efforts to generate homegrown talent in the state through initiatives by educational institutions in Indiana working with industry, but also ensuring the skill upgrading of the existing workforce and the ability to compete in the national and international markets for top-level scientific, engineering, and experienced management talent.

Complicating this effort: the bar is rising. The educational and skills requirements of much of today's health and life sciences industry are increasing and high-demand skill sets are continually shifting.

⁶"PwC 15th Annual Global CEO Survey," 2012.

⁷"*Growing Talent: Meeting the Evolving Needs of the Massachusetts Life Sciences Industry.*" Study conducted by UMass Donahue Institute for the Massachusetts Life Sciences Center, September 2008, page 11.

Many jobs that lie on the lower-skilled end of the spectrum are expected to be automated, math and computer skills are increasingly emphasized among those in middle-skilled jobs, and employers want a high-skilled workforce that is more multidisciplinary and cross-functional.

To maintain this growth trajectory and strong position, Indiana's life sciences stakeholders must be aligned and working together to ensure that they

- Maintain the quantity and quality of health and life sciences workers;
- Ensure the appropriate skill mix and anticipate the qualitative shifts therein;
- Work to maximize interorganization coordination among educators, training providers, and life sciences companies in the state; and
- Have in place the delivery system to offer lifelong education for life sciences employees facing the introduction of new technologies, techniques, and expanding interdisciplinary requirements throughout their careers.

This is no small agenda. Life sciences companies and the educational infrastructure that supports them (and requires its own supply of talent) have day-to-day activities that are impeded when slowed or diverted due to an insufficient worker supply or a skill mix that is imbalanced, or when there is a need to develop or train incumbent workers in-house or in partnership with an educational institution.

BioCrossroads, in its efforts to accelerate a vibrant innovation-driven health and life sciences community in Indiana, recognizes the significance and challenge of ensuring a robust talent base to sustain and build Indiana's considerable healthcare sector. BioCrossroads has brought together a public-private collaboration of industry and educational leaders to help inform the analysis and guide the development of a strategic roadmap for Indiana to follow. To assist in the technical analysis and policy development, BioCrossroads engaged Battelle's Technology Partnership Practice (TPP), with a national track record in identifying and designing comprehensive workforce assessment and development strategies for capturing state and regional growth opportunities, including for Arizona, Connecticut, Maryland, and Oregon. This same team also has completed two highly impactful studies for BioCrossroads and its parent organization, the CICP, on talent issues—the 2015 study of Indy's Talent Dynamics Driving Innovation and Implications for Regional Competitiveness and the 2012 Indiana Study on the Opportunity to Win the Global Competition for College Educated Talent. In late 2015, roughly midway through this effort, the complete staff and capabilities of Battelle TPP were transitioned into a new, independent organization, TEconomy Partners, LLC.

The overall objective of this study is as follows:

Develop a fact-based understanding of the demand and supply of life sciences workers in Indiana, and the factors shaping how demand and supply can be more closely linked.

More specifically, this project assesses the need, requirements, and approaches for developing talent and workforce generation, retention, and attraction strategies for Indiana in the life sciences by addressing the following key questions:

- What workers with which skills will be needed by the life sciences industry?
- What talent supply and capacity does Indiana have now?
- What are the major gaps?
- What should Indiana do?

Assessment Approach: Framework, Methods, and Data Limitations

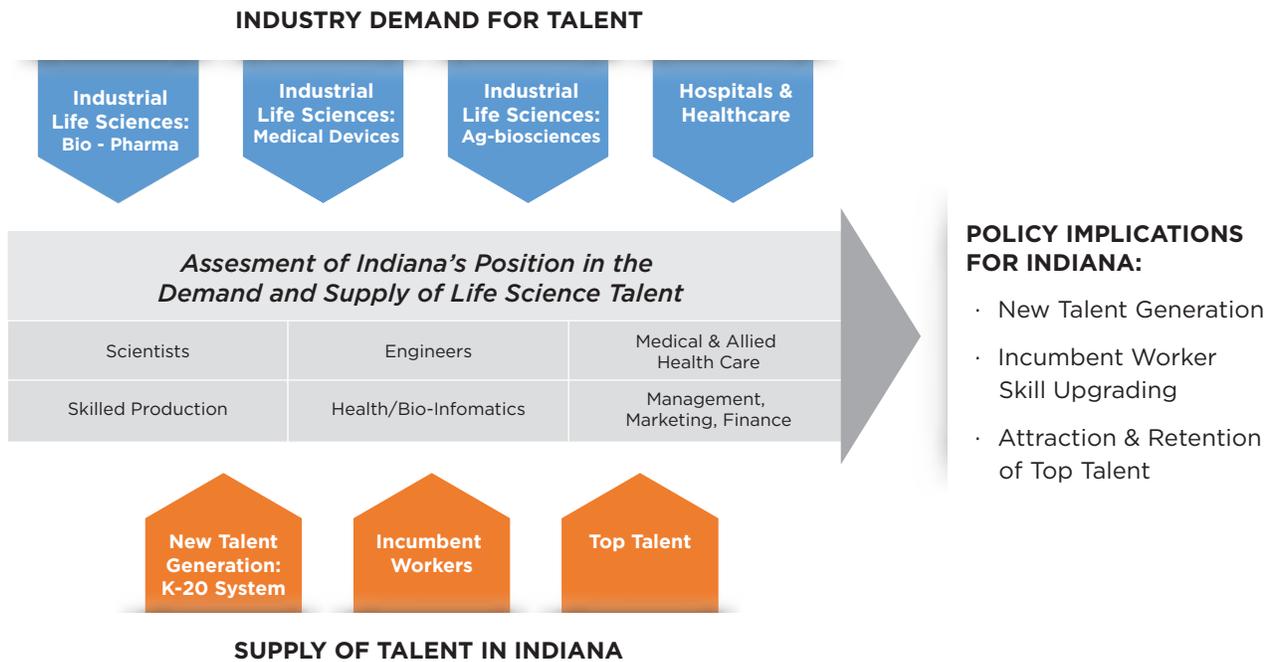
The study framework (see Figure 1) brings together an assessment of industry demand and talent supply around the breadth of occupations and skills required for health and life sciences development. Specific insights around the demand-supply alignment for major occupational groups are discussed in detail with a focus around emerging skills required. The implications of these findings on demand and supply are then placed within a policy context for pursuit of public-private actions in Indiana around the following broad themes:

- New talent generation;
- Skill upgrading of Indiana's incumbent workforce; and
- Attraction and retention of top talent.

To bring together the demand and supply context for health and life sciences talent in Indiana across the broad mix of occupations and skills required, TEconomy undertook a comprehensive effort involving the following:

- *A quantitative approach* utilizing state and federal data to frame the current situation and expectations for the future; and
- *A qualitative approach* soliciting information from companies, academic institutions, and other stakeholders to ensure talent dynamics are fully understood and related.

Figure 1: The Study Approach—Industry Demand and Workforce Supply and Talent Pipeline/Capacity Leading to a Thriving Life Sciences Industry Cluster



Together the quantitative and qualitative approaches can generate differing but complementary levels of detail and nuance, and both are required to best inform the full flavor of workforce needs. In designing this two-pronged project approach, the TEconomy has customized the following to define and profile health and life sciences-related occupations, degrees, and firms:

Quantitative analysis of secondary data including the following:

- Demand for talent—occupational employment, relative concentration, recent trends, future projections, industry utilization of occupations (“Staffing Patterns”);
- Supply of talent—postsecondary graduates from Indiana institutions, graduate retention rates.

Qualitative assessment including the following:

- Survey research—industry employer survey of Indiana health and life sciences companies to assess occupational employment mix, current and emerging skill needs, and technology areas critical to remaining competitive into the future;
- Interviews—one-on-one interviews with Indiana’s leading health and life sciences stakeholders spanning academia, industry, and others; and
- Focus groups—with representatives of Indiana’s health and life sciences industry.

A project Advisory Committee was engaged with representatives from leading health and life sciences companies and health systems, as well as Indiana’s higher education institutions⁸. The Committee served to guide the overall project by providing input and on-the-ground intelligence regarding the analytical framework and approach, key organizations and individuals for interviews, assistance in interpreting results, and ultimately providing input and guidance on what should be done to address areas where intervention is needed.

⁸For a list of participating members of the Project Advisory Committee, see the Appendix to this report.

Demand for Health and Life Sciences Talent: What workers with which skills?

Indiana has succeeded in seeding and growing a life sciences industry cluster that is unique in its breadth and special in its concentrations.

The emergence and continued development of the life sciences industry in Indiana is the product of visionary entrepreneurial Hoosiers, including Eli Lilly, Revra DePuy, Bill Cook and Charles Dotter (Cook Medical), Bill Eason (Roche Diagnostics), and Dane Miller (Biomet) among others, as well as the creation of cutting-edge healthcare organizations, such as IU Health, Riley Children's Hospital, Community, St. Francis, and St. Vincent.

Today, Indiana boasts a robust industrial life sciences base across biopharmaceuticals, medical devices, and the agbiosciences, along with a diverse and growing base of healthcare providers.

Taken together, the industry in Indiana employed more than 265,000 in 2014 in jobs that span more than 4,300 individual business establishments across the state. This represents nearly 11 percent of overall state private-sector employment, or just over 1 of every 10 state jobs. Health and life sciences firms have grown their jobs base by 22 percent since 2001, essentially matching the national growth rate of 25 percent during this period. More recently, the sector has added jobs but at a more modest pace, growing by 2.6 percent since the economic

The Health and Life Sciences Industry Defined

In this study the industry includes:
The *Industrial Life Sciences* spanning:

- Biopharmaceuticals
- Medical Devices
- Agbiosciences

And *Health Services* which includes hospitals, outpatient centers, medical and diagnostic labs, home healthcare services, and nursing and residential care facilities.

The industry in Indiana represents:

- **1 in 10 Private Sector Jobs** across all skill levels
- **22% growth** in industry employment since 2001
- **High Average Wages** exceeding the overall economy in nearly every key occupational group

recovery began in 2009, compared with 6.4 percent for the nation. The industry has a strong, above-average concentration of jobs in health and life sciences in Indiana relative to its overall private sector, measuring 12 percent greater than the national average, and has a specialized employment concentration in three of its four major subsectors—biopharmaceuticals, medical devices, and the agbiosciences.

Beyond the sheer size of employment, the “industrial” life sciences sector (defined below, excludes health services) in Indiana is creating and maintaining high-quality jobs that pay a family-sustaining wage significantly greater than that seen in the overall private sector. At nearly \$95,000 per year, on average, this figure is more than twice the average wage in the overall private sector (\$42,719). Large numbers of high-quality jobs driving innovative businesses translates into a highly impactful industry for Indiana. In its assessment of this industrial life sciences sector, BioCrossroads and the Indiana Business Research Center at Indiana University have calculated an economic impact contribution to the state of Indiana of \$62 billion. In addition, the findings cite Indiana as the second-largest exporter of life sciences products in the U.S., valued at \$9.9 billion⁹.

Definition and Scale of Indiana’s Health and Life Sciences Industry

The industrial life sciences sector encompasses 24 detailed industries that involve research and testing, manufacturing, and distribution. These detailed industries reflect what the Biotechnology Innovation Organization (BIO) has defined as the broad life sciences industry. For purposes of this workforce study, the focus is placed on three broad subcategories to best capture the primary products produced:

- **Biopharmaceuticals** includes the development, production, and distribution of commercially available medicinal and diagnostic substances. The subsector employed 23,201 in 2014, the largest jobs base among the industrial subsectors; employment is down 1.8 percent during the economic expansion/recovery (since 2009); the sector is highly specialized in Indiana with a concentration that is 42 percent greater than the national average. Key Indiana companies include Eli Lilly and Company and Covance.
- **Medical Devices** includes the production and distribution of a variety of biomedical instruments and other healthcare products and supplies for diagnostics, surgery, patient care, and labs. The subsector employed 21,315 in 2014, which is down 7.2 percent during the economic expansion/recovery (since 2009); the sector is highly specialized in Indiana with a concentration that is 86 percent greater than the national average. Key Indiana companies include Roche Diagnostics, Cook Medical, and Zimmer Biomet.
- **Agbiosciences** includes firms applying life sciences knowledge, biochemistry, and biotechnologies to the processing of agricultural goods and the production and distribution of organic and agricultural chemicals and seeds. The subsector employed 9,013 in 2014, which is up 3.5 percent during the economic expansion/recovery (since 2009); the sector is highly

⁹ Economic impacts reported on the BioCrossroads website, see <http://www.biocrossroads.com/>.

specialized in Indiana with a concentration that is 144 percent greater than the national average. Key Indiana companies include Dow AgroSciences, JBS United, and Beck's Hybrids.

The health services sector is composed of 17 specific industries, including hospitals, outpatient care centers, medical and diagnostic labs, home healthcare services, and nursing and residential care facilities. For the industry concept incorporated in this study, the project team has excluded doctors' and dentists' offices as more purely population-driven establishments that are less intensive in their deployment and use of biomedical technologies.

- **Health Services** employed more than 212,000 in Indiana in 2014, which is up 4.2 percent during the economic expansion/recovery (since 2009); the sector has an above-average concentration of jobs in Indiana, 3 percent greater than the national average. Key Indiana companies and research institutions include IU Health and Community Health Network.

The Role of Talent

Innovation-led industry clusters like the life sciences compete on their ability to educate, train, and recruit a qualified workforce that meets the needs of local industry.

Talent touches upon all aspects of economic competitiveness, particularly in knowledge-driven fields such as the life sciences. Life sciences workers are needed to conduct research; translate innovation into product development; improve healthcare techniques and new business ventures; and, ultimately, to manufacture life sciences-related products and deliver healthcare services. Thus, ensuring the availability of an educated, skilled workforce is critical to developing and sustaining a highly competitive, robust life sciences cluster over the long term.

Yet, what makes the life sciences industry sector stand out is its application of a unique and growing body of knowledge on how humans, plants, and animals function. This, in turn, places unique demands on the skills and knowledge of life sciences workers, including understanding advanced molecular biology, operating specialized instrumentation, and interpreting biological data. In addition, the translation of biological knowledge to advancing health treatments requires specific regulatory oversight, rigorous clinical trials, and ongoing quality assurance unique to the life sciences industry sector. Increasingly, the value of biomedical applications is converging with digital innovations involved in Big Data, Internet of Things (remote monitoring and diagnosing), and social media, which is likely to reshape, if not revolutionize, healthcare delivery and patient-physician interactions, and accelerate the movement toward more personalized healthcare.

For the life sciences, it is important to recognize the following:

- Specialized knowledge needed—application of knowledge on how humans, plants, and animals function that often involves unique regulatory and quality control standards;
- Diversity of skills—ranging across scientific research, clinical research, engineering, production, nursing and allied health; and

- Diversity of industry subsectors—ranging from biopharmaceutical to medical devices to agbiosciences to healthcare.

Occupational Structure: Key Health and Life Sciences Groupings

Workforce and talent analysis requires leveraging an occupational structure that transcends “industries”—for example, a microbiologist may work for an agbiosciences company or a pharmaceutical company or a hospital or health system—and allows for an assessment of specific job functions, skills, and knowledge based on the common daily activities of workers across firms. This, in turn, allows for a more meaningful assessment of “talent” in terms of these skills and other worker attributes as well as understanding the make-up of the industry in one state or region compared with another. The balance of workers in the life sciences or other advanced industries can be tilted toward innovation—employing a greater share or concentration of scientists and engineers, for example—or can be more manufacturing focused where the balance is tilted toward production occupations. Certainly, as is the case in Indiana, a state or region can have both.

Certain occupations are clearly life sciences oriented, with knowledge and skills that by definition fall within the scope of the industrial activity in health and life sciences—these include microbiologists, natural sciences managers, soil and plant scientists, biological technicians, and nurses, to name just a few. These primary health and life sciences occupations have been grouped by TEconomy as follows:¹⁰

- Life Sciences-related Engineers
- Life Sciences-related Technicians
- Life Sciences Managers
- Life Scientists
- Health Diagnosing and Treating Practitioners
- Health Technologists and Technicians
- Healthcare Assistants and Support
- Nursing
- Therapists.

Other occupations playing a key role in the industry but not as clearly or fully associated with life sciences operations include production occupations such as machinists, assemblers and fabricators, chemical plant operators, and many others. One major grouping of key occupations for the industry—Information Technology (IT)—falls into this category. Because one cannot determine which computer programmers, or software engineers for example, are specifically employed within the Indiana life sciences industry, the project team has developed an inclusive approach for IT. So taken together, two additional groups have been added as critical to assessing the industry’s workforce:

- IT Occupations—includes all computer-related occupations in the federal occupational classification structure

¹⁰ For a full listing of the detailed occupations that define these groups, see the Appendix to this report.

- Skilled Industrial Production and Support—includes occupations identified for the life sciences by examining national “Staffing Patterns” data that show occupational employment by industry. These detailed occupations make up at least 1 percent of employment in Pharmaceutical, Medical Device, and/or Agricultural Chemicals production and their share of industry employment exceeds their share of employment in all of manufacturing—hence, these occupations and skill sets play a key role in the Life Sciences manufacturing sector(s).

The approach used for IT and skilled production in this study illustrates some of the data limitations that must be acknowledged in conducting detailed occupational employment analyses. While current and historical occupational data are largely complete and comprehensive at the state level, occupational employment estimates by industry (e.g., for the health and life sciences) are often either not available due to limited sampling or suppressed (not published) by state Labor Market Information offices in order to protect the confidentiality of employers. Therefore, the above approach is utilized for groups like IT and skilled production workers.

Data limitations should not, however, diminish the importance of these skills or the importance of gaining access to a qualified workforce in these areas. The production workforce is a large and critical component of the industrial life sciences in Indiana. Life sciences companies must compete with other sectors such as automotive and energy for this workforce and so are affected by the cyclical upturns and downturns in those industries and labor markets. Similarly for IT, health and life sciences companies compete for talent against other sectors where it is easier to operate in a less heavily regulated environment or where ensuring privacy of personal and health information is not at stake.

Assessing Demand: Recent Performance

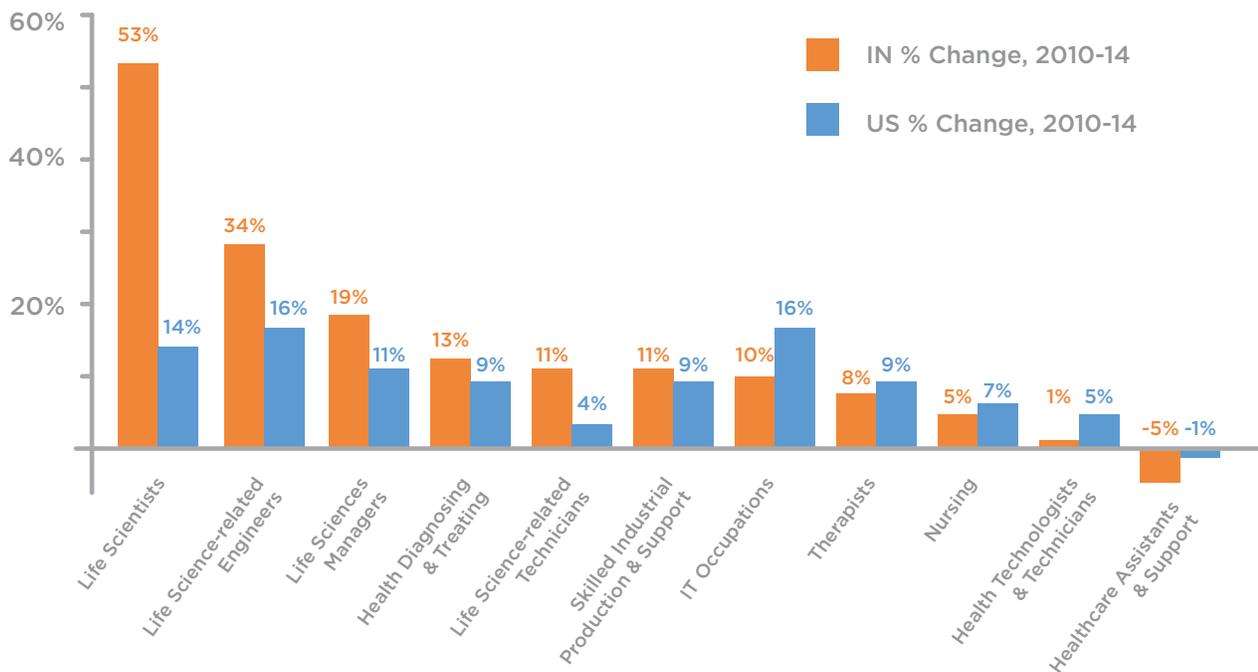
The economic recovery has increased demand for Indiana’s health and life sciences workforce broadly, with 10 of the 11 occupational groups increasing jobs during the 2010 through 2014 period (see Figure 2)¹¹. Even more impressive are those occupations that have seen employment increase at a higher rate compared with the U.S. overall—six of the “growth” groups outperformed the U.S. on a percentage basis signaling particularly strong demand by Indiana companies. While most of these high-growth occupational groups represent major facets of the industrial life sciences workforce, this category also includes health diagnosing and treating jobs, a key high-skilled foundation of the healthcare sector.

The highest-skilled occupations in the health and life sciences are making significant gains in Indiana. Across the board, life scientists, engineers, management, and health diagnosing and treatment positions have among the highest educational attainment and experience requirements in the industry; and each of these groups has experienced double-digit job gains that have outpaced the nation. While percent changes must be interpreted with a cautious eye toward the base employment level—namely smaller occupational groups, such as life scientists, can show greater percent changes

¹¹ Occupational data used in this analysis are examined for 2010 through 2014, with 2010 representing the first year in which a new Standard Occupational Classification system was introduced and implemented and coinciding with the first full year of the recent economic recovery, and with 2014 as the most current year available from both a federal and state occupational data perspective.

on smaller changes in actual jobs—this rapid increase for Indiana, especially compared with the nation, suggests the vitality of the life sciences industry in the state. What is particularly encouraging about growth among these high-skilled groups is their outsized role in driving innovation in the health and life sciences industry. The sector’s scientists, engineers, managers, and physicians develop and deploy diverse, leading-edge life sciences technologies and, even during a period of relatively stable life sciences industry employment overall, this strong hiring signals a continued commitment to innovation and product development in Indiana.

Figure 2: Employment Trends in Major Health and Life Sciences Occupational Groups, 2010–14



Source: TEconomy analysis of Bureau of Labor Statistics, Occupational Employment Statistics.

Indiana’s health and life sciences jobs are not only large and growing nearly across the board during the economic recovery/expansion, but are also highly concentrated, and in many cases specialized in the state relative to the rest of the country. Table 1 presents the occupational measures, including employment levels and location quotients. Location quotients measure the degree of job concentration within a state or region relative to the nation¹². A state LQ above 1.0 represents a greater concentration than the national average. When the LQ is significantly above average, 1.20 or greater, the state is said to have a “specialization” in the occupation.

¹²Location quotients (LQs) are a standard measure of the concentration of a particular industry in a region relative to the nation. The LQ is the share of total state or regional employment in the particular industry divided by the share of total industry employment in the nation. An LQ greater than 1.0 for a particular industry indicates that the region has a greater relative concentration, whereas an LQ less than 1.0 signifies a relative underrepresentation. An LQ greater than 1.20 denotes employment concentration significantly above the national average. In this analysis, regional specializations are defined by LQs of 1.20 or greater.

Four of the major occupational groups have a specialized LQ in 2014—life sciences-related engineers, technicians, managers, and the broad skilled industrial production and support group. Three additional healthcare professional groups also show a greater relative concentration in Indiana—health technologists and technicians, therapists, and nursing. These concentrations reveal the workforce specializations that go in tandem with the broader industry subsector specializations noted above

Table 1: Employment Metrics for Key Health and Life Sciences Occupations, 2014

HEALTH & LIFE SCIENCES OCCUPATIONAL GROUPS	Indiana Empl. 2014	IN Empl. Change, 2010-14	IN Empl. Change, 2010-14	US % Change, 2010-14	Indiana LQ, 2014
Total, All Occupations	2,905,170	180,320	6.6%	6.3%	1.00
Health Diagnosing & Treating Practitioners	27,540	3,110	12.7%	8.8%	0.99
Health Technologists & Technicians	68,770	860	1.3%	5.0%	1.11
Healthcare Assistants & Support	80,600	-3,830	-4.5%	-0.6%	0.95
Life Sciences-related Engineers	20,650	5,290	34.4%	16.4%	1.73
Life Sciences-related Technicians	9,500	920	10.7%	3.5%	1.28
Life Sciences Managers	9,970	1,590	19.0%	10.5%	1.28
Life Scientists	3,250	1,120	52.6%	14.0%	0.68
Nursing	63,460	3,160	5.2%	7.4%	1.04
Therapists	14,490	1,120	8.4%	9.4%	1.08
IT Occupations*	49,500	4,670	10.4%	16.2%	0.61
Skilled Industrial Production & Support*	748,070	71,120	10.5%	8.7%	1.16

*Source: TEconomy analysis of Bureau of Labor Statistics, Occupational Employment Statistics. Note: LQ = Location Quotient.
Indicates occupations that are not primarily life sciences related but play a key, disproportionate role in the industry.

In summary, nearly all health and life sciences occupations across the skill spectrum are growing and well positioned as competitive strengths in Indiana. A good way to summarize the performance and recent demand dynamics of the health and life sciences occupations is an occupational bubble chart illustrated in Figure 3. This chart presents three key characteristics for assessing the region’s current position and recent trends—employment size (relative size of bubble), employment growth (represented on horizontal axis), and employment concentration (LQ on vertical axis).

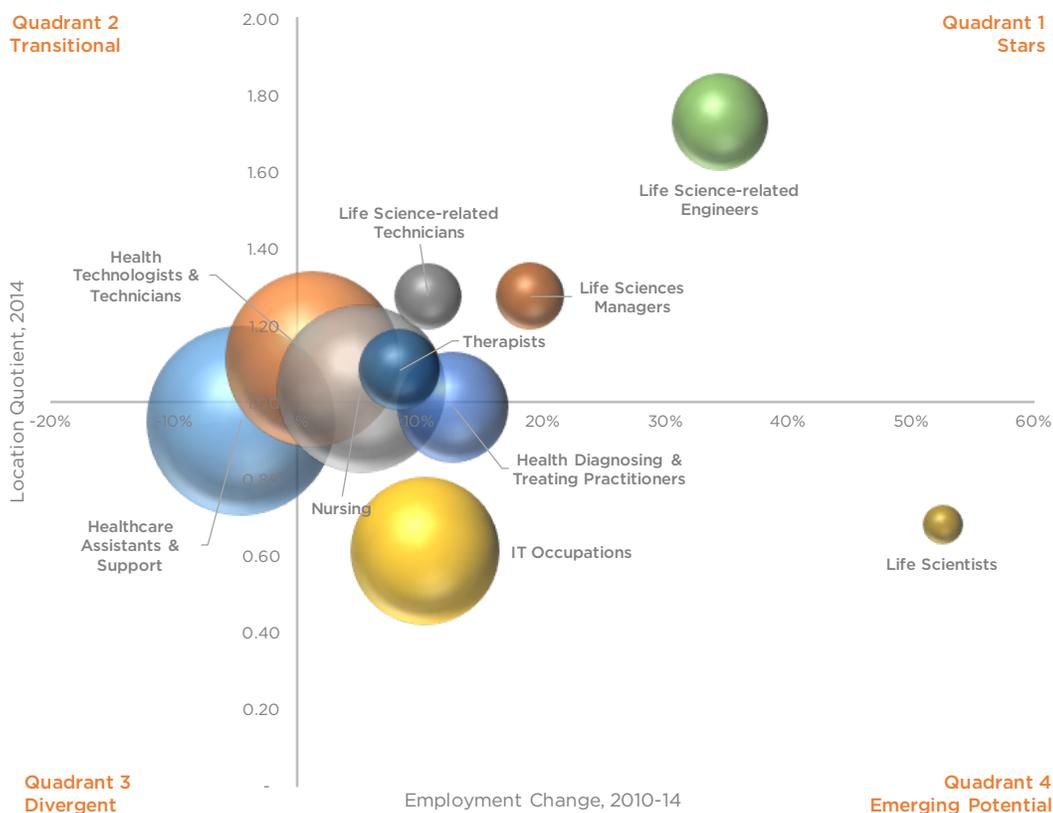
The strong demand for Indiana’s life sciences workers is evident, with nearly all of the bubbles positioned to the right of the vertical axis, indicating job growth since 2010. Where an occupational group is not only highly concentrated or specialized, but has also been growing, it is positioned in the upper-right quadrant of the chart and, based on these characteristics, can be considered a state

“star.” Groups in the lower-right quadrant are growing but not yet exceeding the national average in employment concentration, and thus are considered to be “emerging.”

The relative size of occupational groups in certain healthcare fields is evident by the size of the bubbles, with health technologists and technicians and nursing each currently exceeding 60,000 jobs, and healthcare assistants and support just over 80,000.

While the IT jobs are not all in healthcare or life sciences, they number nearly 50,000 in Indiana and have been in high demand across all sectors, showing “emergence” in the state in recent years. The competition for talent and skills among IT workers is fierce as firms in the health and life sciences sector compete with those across the knowledge economy in finance, insurance, consulting, legal, manufacturing, and pure-play IT firms.

Figure 3: Indiana Health and Life Sciences Occupations: Employment Size, Concentration, and Change, 2010-14



Source: TEconomy analysis of Bureau of Labor Statistics, Occupational Employment Statistics. Size of bubble corresponds to employment level. Note: Data not shown for Skilled Production & Support as employment levels are much higher and distort analysis of other life sciences occupational groups.

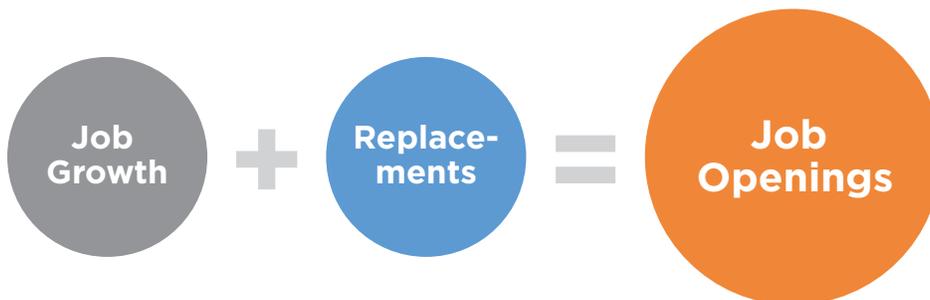
Assessing Demand: Projecting Future Needs

While the experience of the recent past is important to gauge current demand, an effective strategy must also be clearly concerned with where we are heading. Occupational projections developed by Indiana’s Department of Workforce Development (DWD) estimate the expected demand for workers across each occupation. As an aid to understanding underlying dynamics, the data are framed to separate projected annual demand from two distinct vantage points—demand driven by expected occupational growth and demand driven by expectations for “replacement” needs.

Labor demand includes not only the growth of new jobs as an economy or individual sector expands, but also job openings due to replacements. Many workers leave their jobs because of retirement or a change in occupation; consequently, employers have a need for replacement workers in addition to any new jobs that are created. In many cases, the demand for workers due to the need for job replacements within an occupation far outpaces the change in total number of workers due purely to growth.

So, the full measure of labor demand is most complete by adding together both job growth in total employment and the need for replacement workers—which is commonly referred to as job openings. The figure here presents a simple graphic for fully considering job openings.

Depiction of How Job Growth and Job Replacements Relate to Job Openings

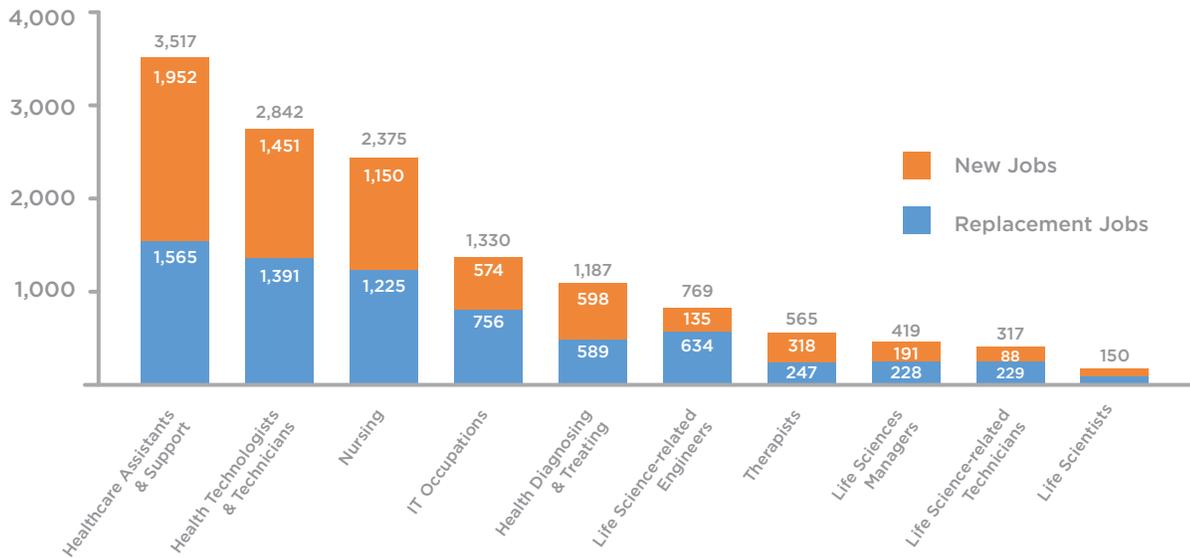


Strong projected demand is expected for health and life science workers, exceeding 12,000 core jobs each year (exclusive of IT and skilled production). The annual employment projections shown in Figure 4 show annual openings for more than 12,000 health and life sciences workers each year, a number that does not include the broader categories of IT workers and skilled industrial production and support, as the employment levels for those groups span many industries across the state. The DWD projects the ratio of replacement to new jobs across the entire economy as roughly 2:1, or 66 percent of openings stemming from replacements. While some industrial life sciences groups such as engineers and life sciences technicians are expected to experience a similarly high ratio of replacements to total openings, healthcare jobs are a different story.

The expected demand for healthcare occupations is much more tilted toward openings created by industry growth. In fact, the split for the healthcare workforce is much closer to 1:1 with each of these groups expected to see between 44 percent and 57 percent of all openings via new jobs. This

dynamic, combined with and further exacerbated by large numbers of openings due to an aging healthcare workforce (particularly for nursing), creates large annual requirements for jobs both in Indiana and throughout the U.S.

Figure 4: Projected Annual Employment Needs in Health and Life Sciences Occupations, 2012-22



Source: TEconomy analysis of Occupational Employment Projections, Indiana Department of Workforce Development.

Data not shown for Skilled Production & Support as employment levels are much higher and distort analysis of other life sciences occupational groups.

Indiana’s DWD expects nursing jobs to grow by 17.7 percent through 2022, with nursing currently designated number 1 among the Hoosier Hot 50 Jobs list, a list of “the top 50 fastest growing, high-wage jobs of tomorrow.”¹³ In fact, nursing is noted by DWD as a hot job with very strong hiring needs.

Also among just the top 25 jobs in this “Hot 50” are the following in health and life sciences:

- Registered Nurse (#1)
- Licensed Practical Nurse (#6)
- Mechanical Engineer (#13)
- Medical Services Manager (#14)
- Pharmacist (#16)
- Family Physician (#17)
- Dental Hygienist (#21)
- Physical Therapist (#23)

¹³Indiana Department of Workforce Development, Hoosier Hot 50 Jobs; for list and methodology, see <https://netsolutions.dwd.in.gov/hh50/jobList.aspx>.

- Industrial Engineer (#24)
- Computer Systems Analyst (#25).

With a sound understanding of demand, both in terms of recent performance as well as expectations going forward, the rest of this section seeks to further frame Indiana’s quantitative results versus the performance of other states and to analyze qualitative input on demand from employers.

Assessing Demand: Benchmarking Indiana’s Demand for Life Sciences Workers vs. Other States

Indiana’s growing health and life sciences jobs reflect strengthening economic conditions in recent years both broadly across all industries as well as more specifically in the labor markets for life sciences. In many instances, Indiana’s jobs are growing faster than the nation, an important and meaningful finding. But how do Indiana trends stack up against those in other states? Comparisons against other regional peers, especially those whose life sciences industries are similarly structured, can provide a useful gauge on relative performance.

Based on input from the Project Advisory Committee, the TEconomy project team compared the recent performance of Indiana’s health and life sciences employment against seven other large and leading life sciences states shown in Table 2, with check marks identifying where each state has a “specialized” employment concentration across the major life sciences industry subsectors. States were selected for their varied and broad strengths, similar to Indiana.

Table 2: Indiana and Comparison States, Employment Specialization by Life Sciences Subsectors

STATE	Non-Hospital LifeSciences IndustryEmpl. (2012)*	Industry Specializations
Indiana	57,644	    
California	235,864	  
Illinois	78,561	  
Massachusetts	77,817	   
Minnesota	47,997	
Missourri	28,109	 
North Carolina	66,123	  
Utah	25,101	  

INDUSTRY SPECIALIZATIONS

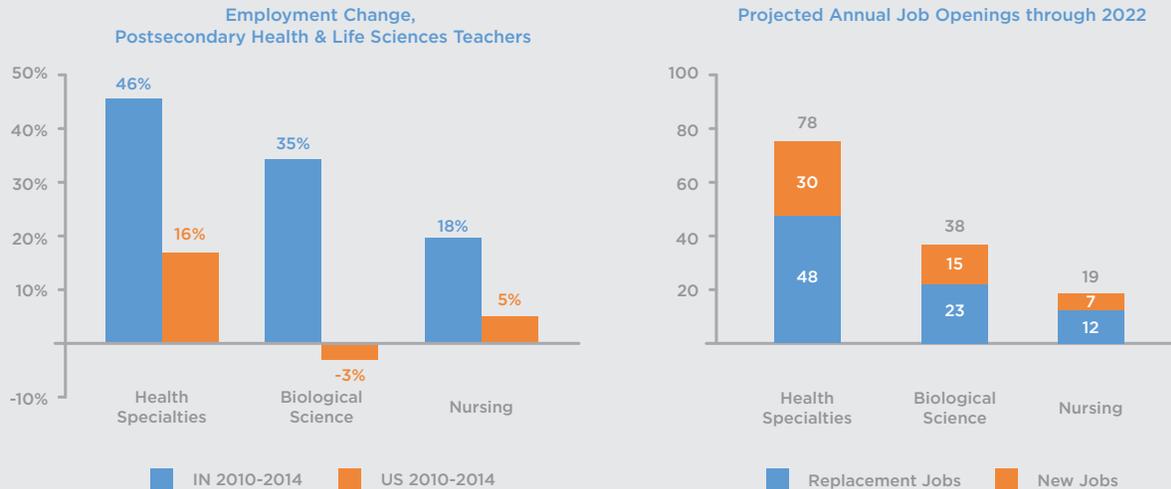
-  Agbio
-  Medical Devices
-  Drugs & Pharma
-  R&D & Medical Labs
-  Hospitals

*Source: TEconomy/BIO State Bioscience Jobs, Investments and Innovation 2014. Employment specialization not shown for Bioscience-related Distribution, a sixth major industry subsector.

Demand for Life Sciences Teachers and Instructors at Indiana's Colleges and Universities

In addition to skilled, specialized talent needed by the industrial life sciences and health care businesses in Indiana, high-skilled and highly educated teachers, professors, and instructors for the state's colleges and universities are similarly in high demand. These professionals represent one of the most important roles in talent generation and are critical to maintaining and ensuring a robust and high-quality health and life sciences talent pipeline for Indiana.

In direct health and life sciences disciplines, there were 5,710 postsecondary teachers employed in Indiana in 2014 with a specialized concentration in two of the four categories—agricultural sciences teachers (LQ is 2.16) and nursing teachers (LQ is 1.21). Recent demand has been very strong in Indiana, with double-digit job growth rates that have outpaced the national trends. Expected annual job openings in three of the four categories are expected to total 135 per year, though this figure does not include the agricultural sciences for which such projections are not available.



Note: Employment change for Agricultural Sciences not shown due to no available 2010 employment value; projections also not available.

Organizing Occupational Groups for the Benchmarking Assessment

The occupational structure developed for Indiana’s health and life sciences workforce is again utilized in the state comparisons; however, given the analysis includes 7 comparison states and 11 occupational groups, higher-level groupings were developed to more succinctly present the comparisons. These include creating the following major categories:

Industrial Life Sciences Occupations include the following:

- Life Sciences-related Engineers
- Life Sciences-related Technicians
- Life Sciences Managers
- Life Scientists

Healthcare Delivery Occupations include the following:

- Health Diagnosing and Treating Practitioners
- Health Technologists and Technicians
- Healthcare Assistants and Support
- Nursing
- Therapists

Skilled Industrial Production and Support and IT Occupations—same concepts as originally presented.

Employment size, trends, and relative concentration (LQs) are shown in this section in bubble charts. Occupational wages and wage trends are presented in bar charts.

KEY FINDING:

Indiana is in the middle of the pack in employment performance but gaining ground in wages (see Figure 5).

- Among those occupations most clearly and directly related to the health and life sciences industry and its core activities, Indiana has an employment concentration 6 percent greater than the national average; has grown by nearly 5 percent since 2010; and pays average wages for the combined life sciences and healthcare sectors of \$57,548, just below the national average.
- Combining healthcare delivery with the industrial life sciences jobs yields a total of 298,000 jobs in Indiana. Eighty-five percent of these jobs are in healthcare, which has grown more slowly than Indiana's rapid pace of industrial life sciences jobs—about 2 percent compared with 26 percent, respectively.
- Utah, with the smallest overall industry among the comparison states, has grown these jobs by nearly 14 percent since 2010, with key specialized concentrations in life sciences engineering and technician jobs.
- Massachusetts, the most specialized and among the fastest growing in its healthcare and industrial life sciences workforce, has added jobs at a nearly 11 percent rate since 2010 and has a breadth of specializations in nearly all of the industry's occupational groups.

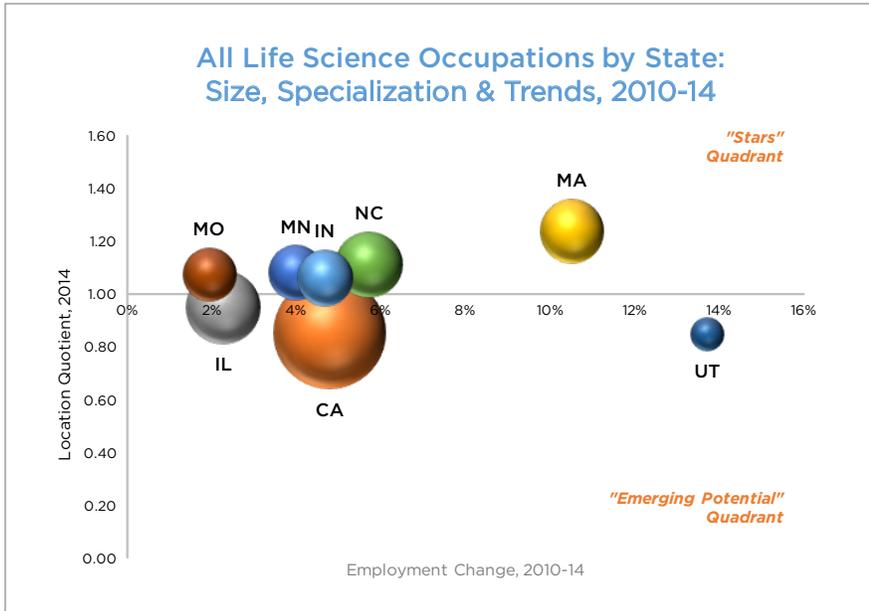
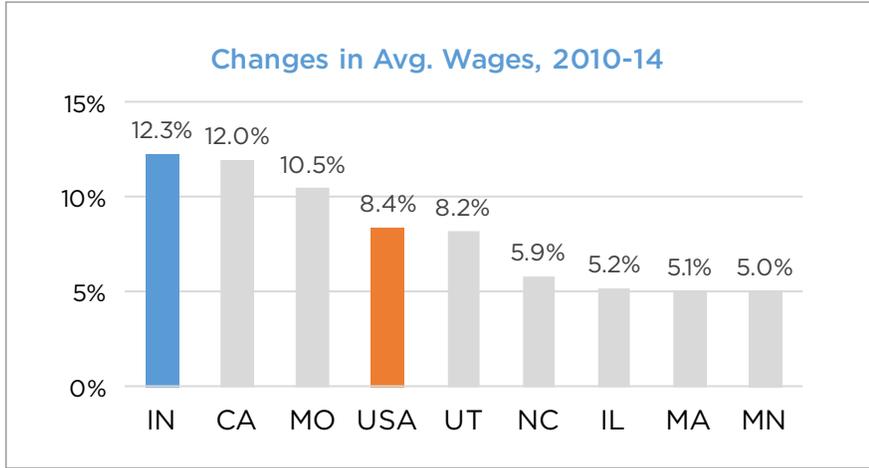
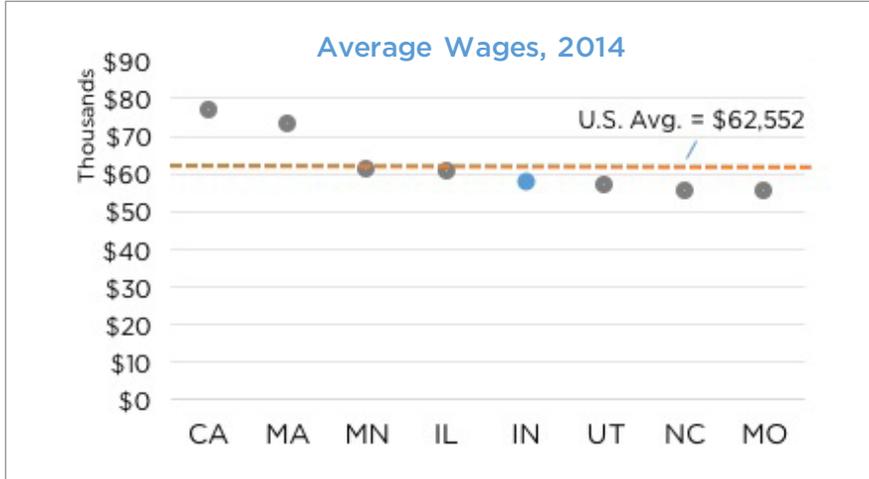


Figure 5: All Life Sciences Occupations—Healthcare Delivery and Industrial Life Sciences Occupations Combined



KEY FINDING:

Indiana is among the leaders with strong recent employment and wage growth (see Figure 6).

- In the core “industrial” life sciences occupations that span engineering, technicians, scientists, and management outside of healthcare, Indiana employs over 43,000, yielding a highly specialized employment concentration—an LQ of 1.36 in 2014—that is reflective of the importance of the industry relative to Indiana’s economy. These jobs have grown rapidly in Indiana, rising nearly 10 percent during the economic recovery/expansion since 2010.
- The strong demand for Indiana’s life sciences talent base is helping to drive up wages, which have increased by nearly 10 percent since 2010; however, average wages for these selected occupations in Indiana are lowest among the comparison states at just under \$70,000 per year (note, however, when considering the full employment base of life sciences in Indiana, the average wages reach nearly \$92,000).
- Indiana’s 43,000 jobs lie behind California, Massachusetts, and Illinois, but with 26 percent job growth since 2010, Indiana is closing the gap.
- California’s large and leading life sciences industry is evident by the size of the bubble in Figure 6, with more than 176,000 workers in industrial life sciences jobs in 2014. Even with a large starting base, these occupations have added jobs in California at a rapid rate, increasing by nearly 13 percent since 2010.

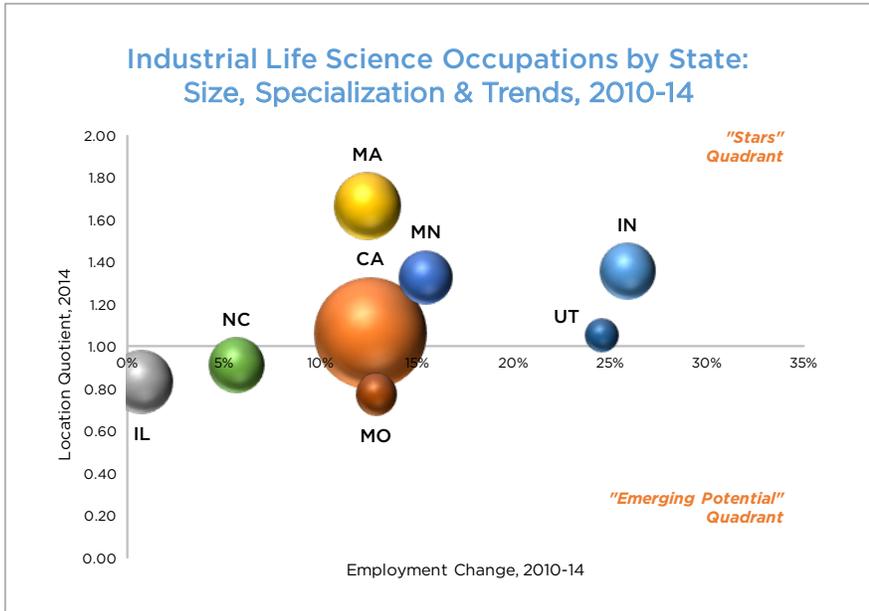
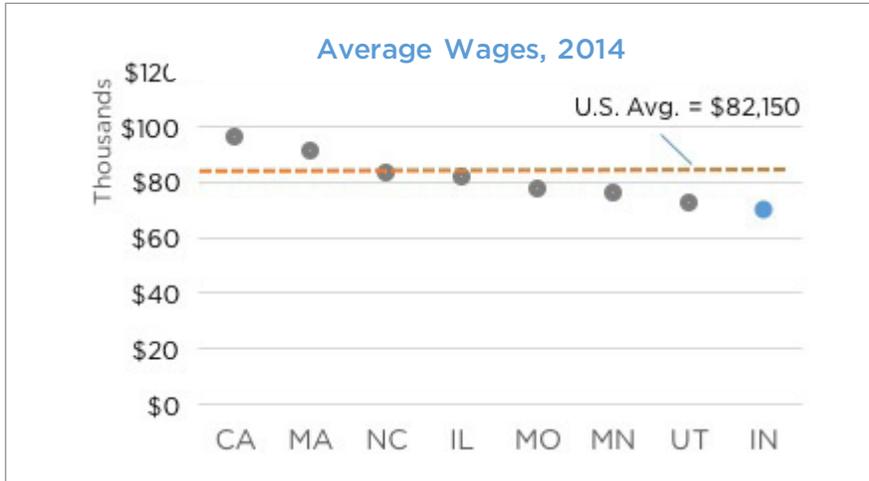


Figure 6: Industrial Life Sciences Occupations

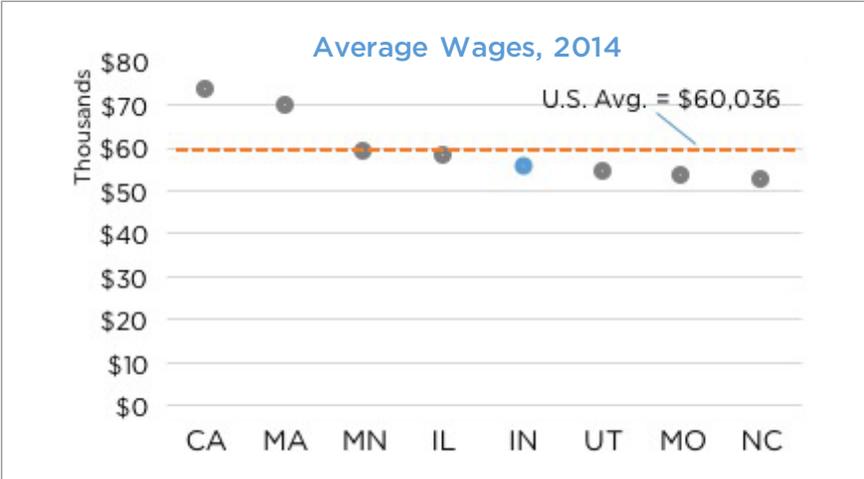
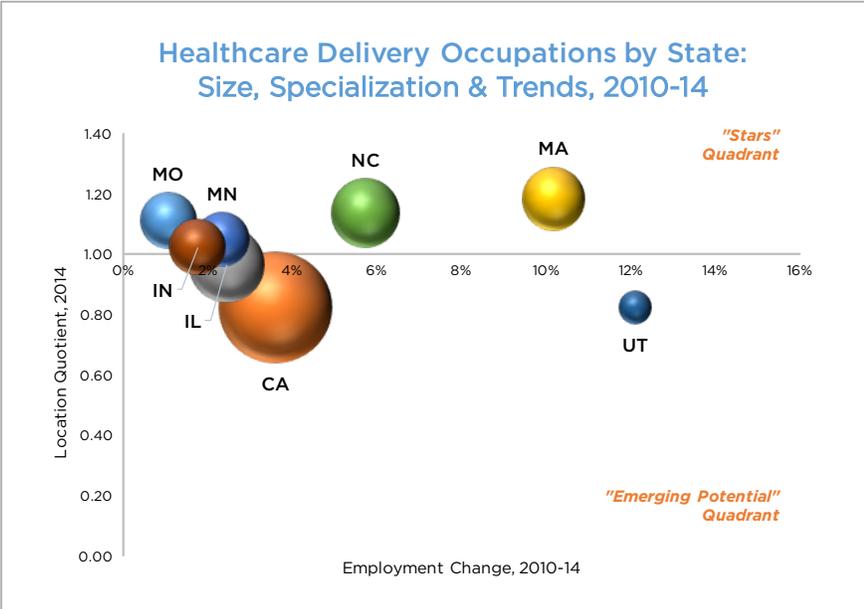


KEY FINDING:

Indiana's healthcare sector has been held back by slower job growth but is making strong wage gains (see Figure 7).

- Indiana's healthcare workforce has grown by nearly 2 percent since 2010, totaling more than 250,000 jobs that span treating and diagnosing, nursing, therapists, health technologists and technicians, and healthcare assistants/support.
- Wages in healthcare delivery jobs in Indiana fall just below the national average—averaging \$55,477 in Indiana compared with \$60,036 for the nation overall. Indiana is growing average wages at a rapid rate, increasing by 12 percent since 2010 and ahead of growth for the U.S. and all of the comparison states.
- Utah, Massachusetts, and North Carolina have seen their respective healthcare workforces grow faster than the other comparison states. Among these states, Massachusetts and North Carolina have the most concentrated and nearly specialized employment with LQs of 1.18 and 1.14, respectively.
- In a population-driven sector such as healthcare, it is much more difficult to rise to a specialized concentration, and a highly concentrated or specialized LQ typically signals the presence of strong academic medical and research institutions. Missouri also has a high LQ, at 1.11 in 2014.

Figure 7: Healthcare Delivery Occupations



KEY FINDING:

For skilled industrial production and support jobs, Indiana is specialized, outpacing nearly all comparison states in job growth; wages are markedly lower (see Figure 8).

- As a leading advanced manufacturing state, including in the life sciences, Indiana has a specialized employment concentration in skilled industrial production and support jobs that plays a crucial role in the life sciences. These occupations have grown during the expansion, rising by 11 percent. Indiana has the highest LQ among the benchmark states, a specialized concentration of 1.16 in 2014.
- Average wages are markedly lower for these workers in Indiana, averaging just over \$41,000 in 2014 compared with a national average rate of almost \$47,000.
- Illinois is the only other comparison state with a similar concentration of these skilled production jobs, with an LQ of 1.11. Wages in Illinois just exceed the national average.

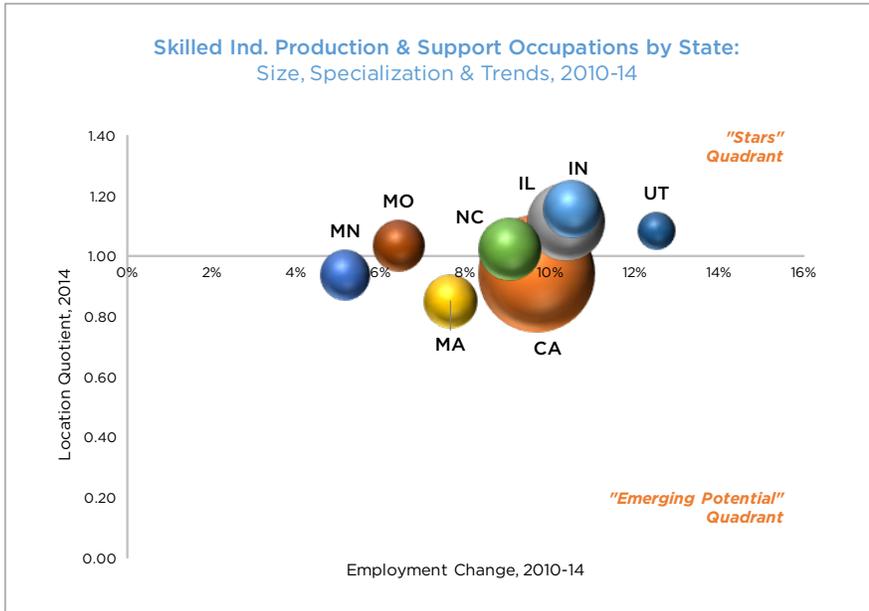
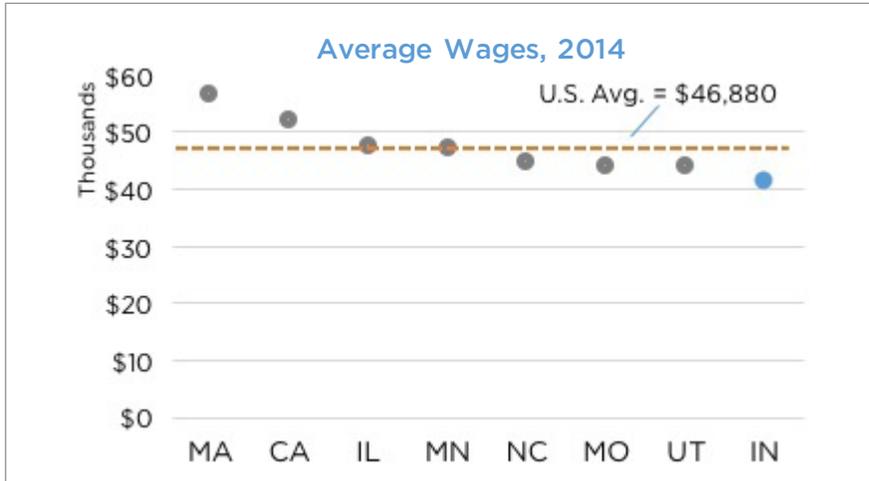


Figure 8: Skilled Industrial Production and Support Occupations

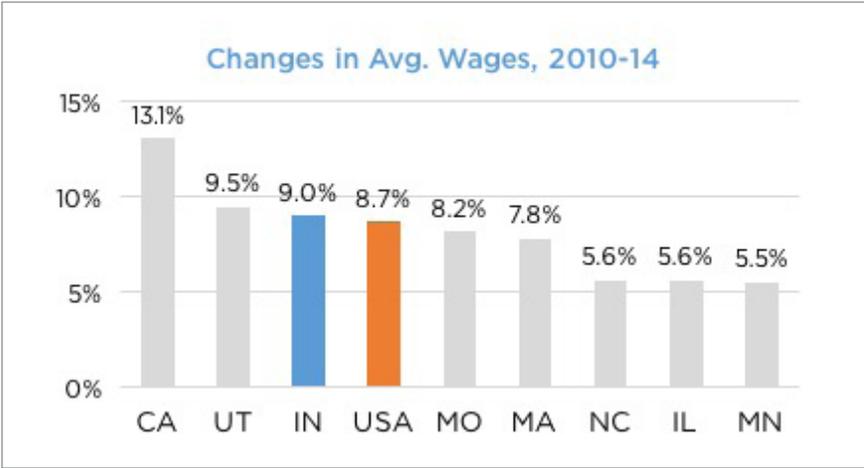
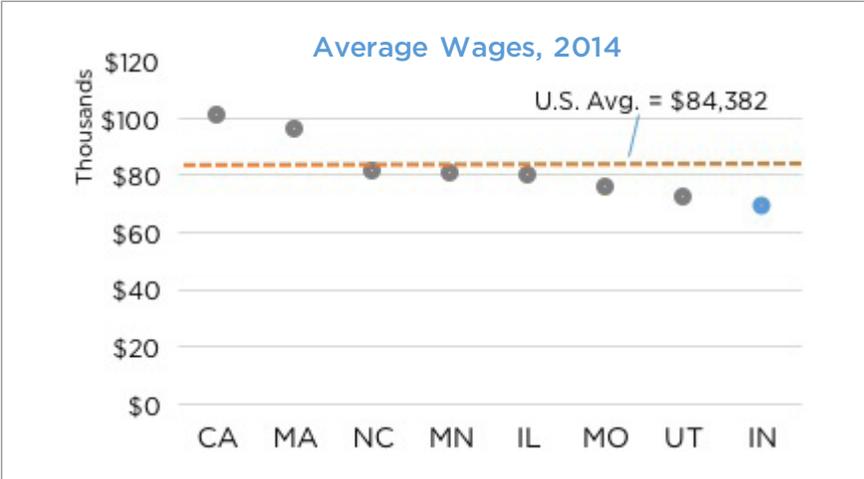
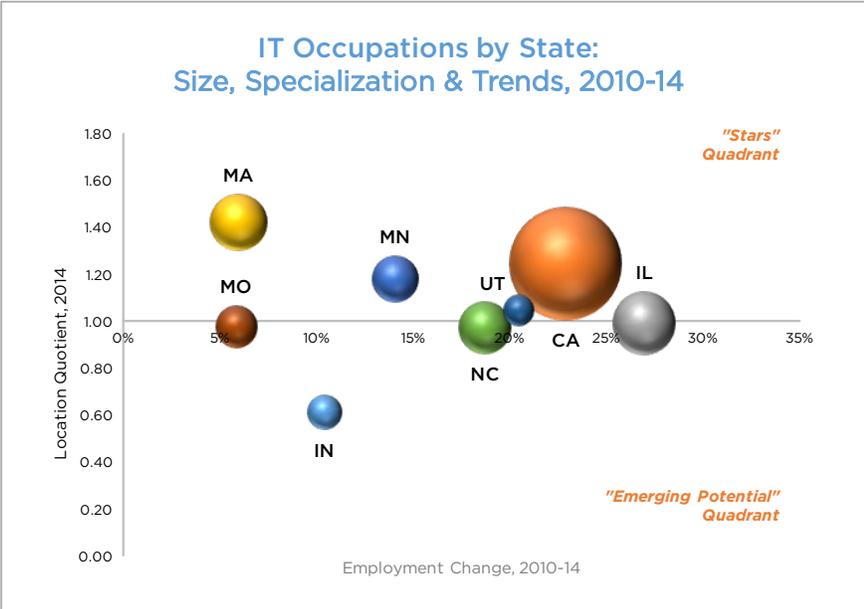


KEY FINDING:

Indiana is lagging other states in IT occupations commonly utilized in the health and life sciences (see Figure 9).

- Indiana's position in broad IT occupations is emerging, though is generally lagging those states in the comparison set, particularly in size and relative concentration of employment. These jobs in Indiana are relatively under-concentrated, with an LQ of just 0.61 or 39 percent, a figure that is less concentrated than would be expected given the size of the state's economy.
- The recovery and economic expansion have yielded strong demand for IT specialists across a number of fields. Indiana and each of the comparison states have seen job growth in IT jobs since 2010, with most reaching double digits. Illinois and California have led in IT-related job growth, increasing employment by 27 percent and 23 percent, respectively.
- California and Massachusetts, as global leaders in IT and in economies that leverage IT-related skills in other industries, stand out with high, specialized LQs. Minnesota also has a specialized IT talent base, though it is clearly more modest in size than that in California.

Figure 9: IT Occupations Utilized in Health and Life Sciences



Summary of Key Findings from Regional Benchmarking: Indiana's Strengths Revealed, but Challenges Emerging

The benchmarking analysis suggests that, while the broad trends in health and life sciences occupations are positive for Indiana, a closer comparison with competitor states shows challenges that need to be addressed.

Turning first to competitive strengths, Indiana's life sciences industry growth trajectory comes through in a head-to-head benchmarking analysis with competitor states, including the following:

- Indiana is rapidly growing its sizable and specialized industrial life sciences talent base.
- The economic recovery of Indiana's large advanced manufacturing sector, including life sciences, is driving strong demand for a skilled production and support workforce.

Challenges that Indiana needs to be concerned about include the following:

- The state is not growing as rapidly as others in its healthcare workforce, a finding that, at least in part, reflects "anticipatory layoffs" during this period, following the 2010 adoption of the Affordable Care Act (ACA).
- Indiana lags in its growth and concentration of IT occupations.
- Indiana's average wages tend to be lower than the comparison states, which, from a narrow business climate perspective, can seem to be a competitive advantage, but more widely focused, can be seen as an area of real concern when competing for top talent in areas such as IT and experienced scientists. Still, there is promising evidence that Indiana is quickly catching up.

Addressing Demand: Findings from Employer Surveys, Focus Groups, and Interviews with Indiana Health and Life Sciences Companies

The quantitative assessment of health and life sciences occupations reveals strong demand in recent years, as well as expectations for continued strength in hiring. So, what are the hiring plans of Indiana employers? Do these plans align with the preceding data analysis? And what do employers say about their greatest needs for talent? This section explores the vantage point of the Indiana life sciences and healthcare employers and what the project team has learned from the following interactions:

- **Employer interviews** with human resources and other executives spanning each of the major life sciences subsectors.
- **Employer survey**—a web-based survey developed specifically for Indiana health and life sciences employers to address the following:
 - The occupational skill mix utilized and deployed by the industry.
 - For specific health and life sciences jobs—recent and expected hiring and vacancies; minimum expectations for experience and education; recruiting geography; difficulty in identifying and hiring qualified candidates.
 - Identifying emerging technology areas that should be emphasized in education and training curriculum in the near term (next 5 years) for both today’s students as well as for the incumbent workforce.
 - Specific types of courses or seminars they would like to see offered for their existing employees.
- **Employer focus groups**—conducted among similar life sciences subsector firms; the study team had participation in two industry focus groups from a group of medical device companies and association representatives as well as hospitals and health systems representing healthcare providers across the state.

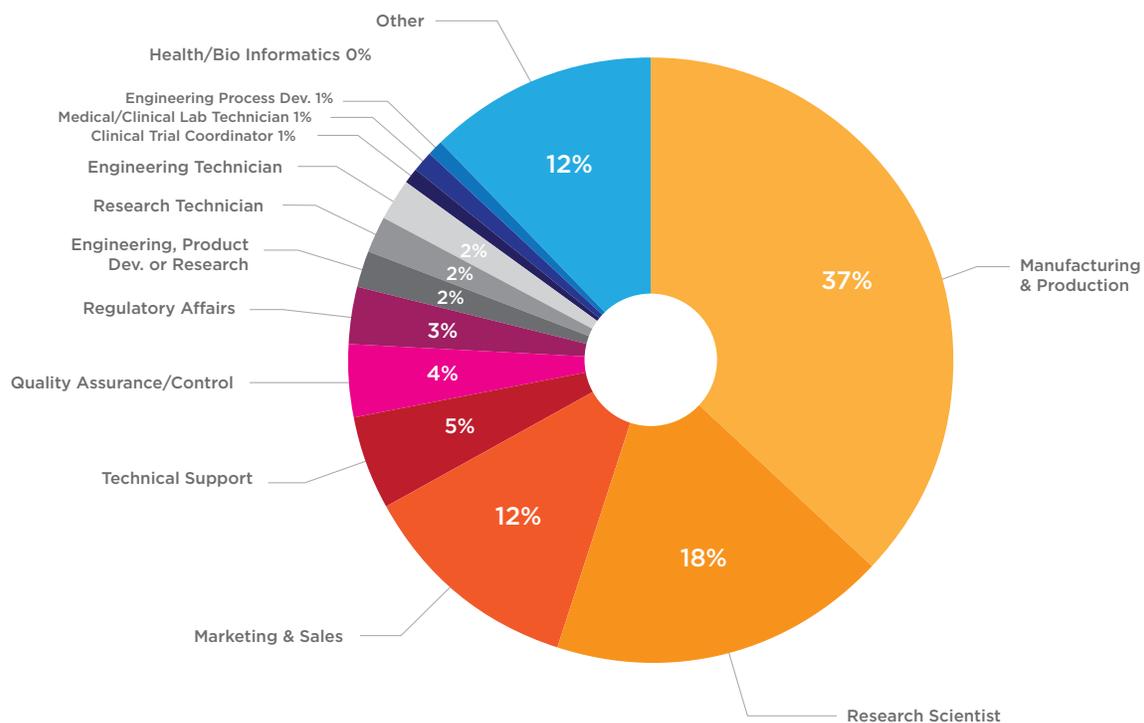
In interviews and focus groups, employers indicated a strong demand for workers and challenges for finding talent as the overall labor market has improved and there is competition for qualified workers, particularly for production workers, with other Indiana industries. Specific skill sets and workers with specialized experience are difficult to find, and recruitment to Indiana can be challenging. These and other common themes raised by non-hospital life sciences employers in the qualitative assessment are highlighted in Figure 10. Following this are the feedback from hospitals and health systems that address the healthcare workforce.

Industrial Life Sciences Employer Surveys and Interview Insights

Seven of Indiana’s largest, industrial life sciences companies responded to the workforce and talent survey, completing the survey questionnaire to varying degrees. These companies represent more than 19,000 state life sciences jobs or about 41 percent of the non-hospital and non-distribution core of the industrial life sciences industry base that spans the agricultural biosciences; drugs and pharmaceuticals; medical devices; and research (including biotech), testing, and medical laboratories. These firms report hiring just over 2,000 in Indiana over the last year.¹⁴

Figure 10 presents the current occupational employment structure of the responding companies, though it is important to note that not all respondents provided occupational detail. The distribution of jobs reflects not only a focus on manufacturing in Indiana among the firms, but also the major role of research scientists in conducting R&D to drive product innovation. Marketing and sales jobs represent a significant share of employment as well. Engineering, which in the survey was divided into two functional categories, forms a 4 percent share when combined. The more niche, specialist jobs compose a smaller share of overall employment, though as the survey, interviews, and focus groups have found, these often represent the most difficult jobs to identify, attract, and hire qualified candidates.

Figure 10: Occupational Employment Structure of Industrial Life Sciences Firms Responding to Survey

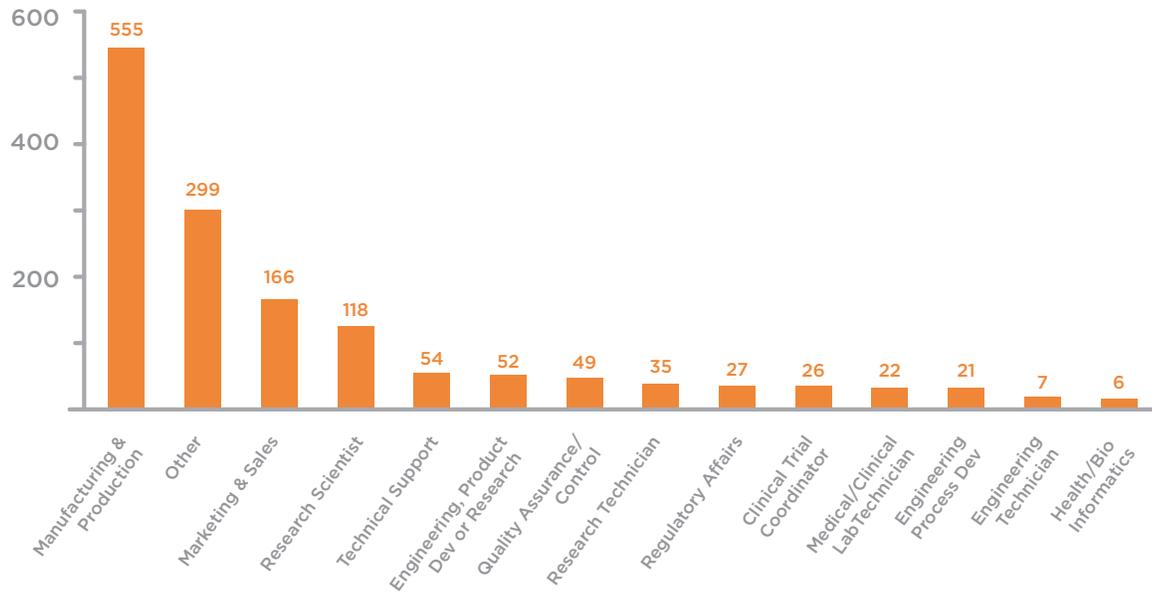


Source: TEconomy Indiana Life Sciences Workforce and Talent Survey, 2015. Note: not all responding firms reported occupational employment details.

¹⁴Reference period for recent hiring went back to September 2014, 1 year from the start of the survey collection period that lasted through December 2015.

Recent hiring is largely reflective of the current occupational structure of the industry (see Figure 11), though there are several occupations for which recent hires represent a significant share of the current employment base, exceeding 10 percent of the existing workforce. These include engineers (in both product and process development), medical and clinical lab technicians, health and bioinformatics, and clinical trial coordinators. Outside of medical/clinical lab technicians, these areas represent several that have been raised by employers in interviews and focus group discussions as high-demand talent needs.

Figure 11: Recent Hires of Industrial Life Sciences Companies in the Last Year

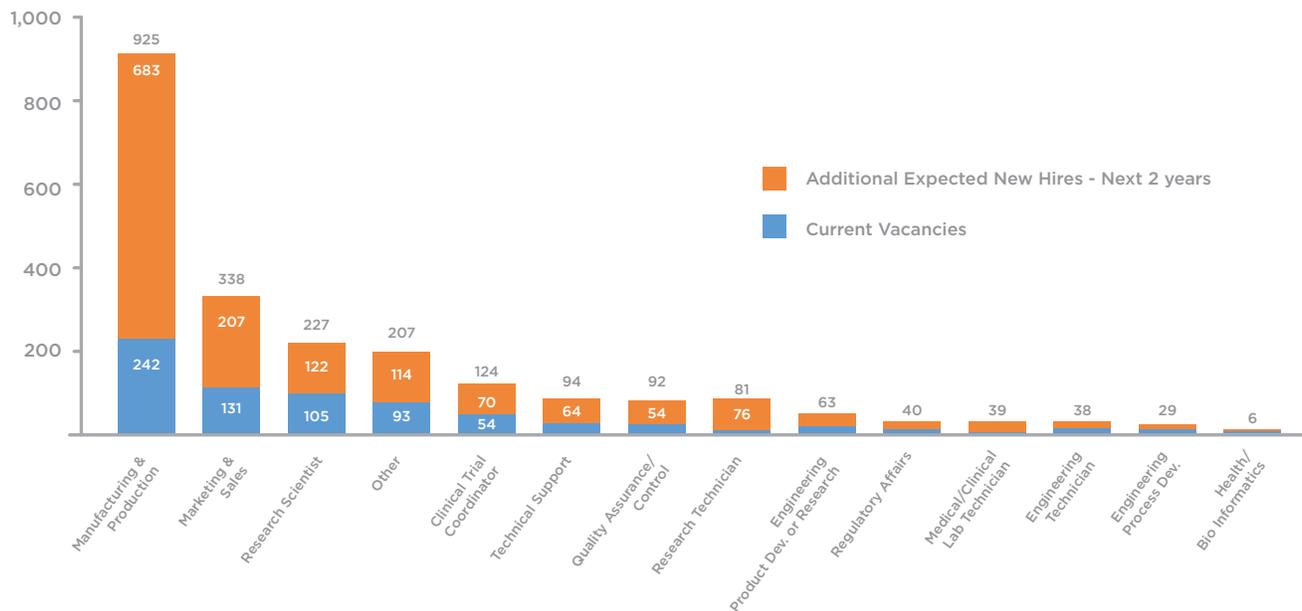


Source: TEconomy Indiana Life Sciences Workforce and Talent Survey, 2015. Note: not all responding firms reported occupational employment details.

Among the companies reporting occupational detail, expectations are to hire the equivalent of 15 percent of their current workforce (see Figure 12) to fill both current vacancies and projected additions over the next 2 years. Projected additions will come from new jobs to be created, as well as replacing existing workers who will leave through retirements and other reasons. In terms of relatively high-demand occupational groups exceeding this 15 percent threshold, Indiana companies have strong hiring needs in the following groups:

- Clinical trial coordinators
- Medical/clinical lab technicians
- Research technicians
- Engineers
- Marketing and sales
- Manufacturing and production.

Figure 12: Industrial Life Sciences Current Vacancies and Expected New Hires over Next 2 Years



Survey respondents were asked about the degree of difficulty (or ease) they experience in hiring across the various occupational groups. Among the non-hospital life sciences firms, the following were cited as being “very difficult” to hire by at least two companies:

- Research scientists
- Health/Bio informatics
- Marketing and sales.

Beyond the quantitative information from the industrial life sciences employer survey, a number of key insights emerge from industrial life sciences employers through open questions and follow-up interviews, presented in Figure 13. These insights focus on a range of concerns—from broad labor market challenges of operating in Indiana that one might hear from companies in any advanced industry (such as aging workforce, concerns about recruiting workers to the Midwest)—to those that overlie the life sciences industry as a whole (such as a lack of life sciences career pathways)—to those that address very specific occupations and skill sets (such as a need for bioinformatics and engineering talent).

Figure 13: Key Themes from Discussions with Industrial Life Sciences Companies and Industry Association Representatives

Broad Industry-related Challenges & Concerns	Demand for Specific Occupations, Skill Sets, Technology Areas	Broader Labor Market Challenges in Indiana
<ul style="list-style-type: none"> • Creating career pathways for life sciences • Perception by prospective workers of limited opportunities in the industry • Strong, broad demand for specialized technical knowledge of life sciences industry: <ul style="list-style-type: none"> • Regulatory knowledge • Good Manufacturing Practices (GMP) • Electronic health data • Clinical trials mgmt. • Insurance reimbursements 	<ul style="list-style-type: none"> • Experienced scientists & executives • Scientists with technical & business savvy; “multidimensional” • Increasing importance of data/informatics & demand for workers • Bioinformatics; precision medicine & agriculture; connected/digital health; other “Big Data” & statistical applications • Mechanical engineers especially those with exposure to production • Broad & increasing demand for “IT workers” • Machine operators with soft skills • Concerns about life sciences production workforce particularly qualified workers in medical device mfg. 	<ul style="list-style-type: none"> • Aging workforce in both scientific & particularly in production jobs • Recruiting/attracting talent to the state & talent retention • Perception of the state as an unattractive place to live • Recruiting nationally for many positions in life sciences • Improving labor market leading to competition with other industries for qualified workers • Lack of diversity of qualified candidates in local labor markets

Putting together the quantitative survey information and insights from open-ended questions and follow-on interviews, specific occupational and skill needs come through loud and clear from Indiana’s life sciences employers:

- **The need for “IT workers” is expressed repeatedly and consistently across each subsector of Indiana’s health and life sciences industry as a major and critical high-demand need.** The industry competes with other advanced industries in Indiana for IT talent, and employers relate that, as the labor market improves, this competition gets even more intense. One large life sciences company, citing the lack of IT talent in Indiana as a “huge issue,” notes being unable to fill an open position for a Vice President of Information Technology for 2 years.

- **A specialized IT skill set also emerges as a critical need among industrial life sciences companies—the need for workers in bioinformatics.** As a specialized field, bioinformatics requires an interdisciplinary academic and experiential background that spans biology, statistics, computer science, and hands-on experience working with vast amounts of data in varied forms and from varied sources, and it ranges across all the major life sciences subsectors from the agbiosciences to drugs and pharmaceuticals, biotech, and medical devices. While employers do not tend to hire these workers in large numbers, as will be shown in the survey-related data below, the demand for these workers is high as ever-increasing reams of data are generated in the life sciences and opportunities for mining and exploiting these data to drive innovation are escalating. In interviews and discussions regarding workforce, “bioinformatics” or simply “informatics” is often top of mind.

In the agricultural biosciences, companies conducting extensive R&D have needs for the blend of skills required in bioinformatics spanning science, analytics, math, and applied statistics, with applications in precision agriculture. For example, a soil scientist utilizes weather and other data to develop hybrid seeds or genetic traits and makes real-time decisions in prescribing planting methods and timing to farmers. Understanding and optimizing plant genetics occur at the nexus of math and sequencing, looking at data regarding the historical performance of hybrid seeds and plants and using math to develop predictive models of performance.

- **In the life sciences, there is broad demand—not only in Indiana, but nationally—for multidisciplinary or multidimensional workers whose educational backgrounds and/or experiences have created competencies not only in one scientific or technical area, but also in a functional business capacity or another technical discipline.** While employers emphasize it is easier to develop business skills and expertise in someone already scientifically trained, rather than the opposite, these are people with tremendous value for today’s life sciences companies. Likewise, companies need biologists with computer science or informatics training, engineers with regulatory knowledge, and scientists who can manage R&D partnerships with other organizations. Recent national studies have confirmed these findings.

A recent biopharmaceutical talent report by PwC confirms these demand dynamics within the context of an industry changing its R&D model and culture out of economic necessity.¹⁵ The study finds 35 percent of life sciences companies have “revamped” their R&D structure and approach in the prior 3 years, in a shift toward R&D partnerships and alliances, most often with academic medical centers and third parties including contract research organizations. The implications for talent are significant:

“The most needed skill sets for R&D have moved away from pure scientific expertise to regulatory knowledge and relationship skills. Developing and managing outside partnerships and regulatory science are the two most sought-after skills today.”

¹⁵“New Chemistry: Getting the Biopharmaceutical Talent Formula Right,” PwC Health Research Institute, February 2013.

For its 2014 report on workforce trends, the Coalition of State Bioscience Institutes (CSBI) surveyed more than 100 U.S. life sciences companies. Among the themes emphasized by hiring managers and corporate leadership were the demand for the following:¹⁶

- Individuals with strong science skills in combination with “multidisciplinary academic training and experience”; and
- Scientists, engineers, and clinicians with “cross-functional” skills including the ability to communicate well and to more successfully interact with internal and external partners.

Echoing these demands, the study emphasizes the need for “Professional Hybrids”—those that go beyond simply having a science degree alone. Such individuals are able to “link scientific knowledge with business acumen to advance a product or technology through its life cycle.”

- **Indiana’s large and leading cluster of orthopedics firms in Warsaw have identified strong needs for mechanical engineers and in particular those with some experience or exposure to production environments, including internships or co-op experiences.** OrthoWorx, a community-based initiative that works strategically and collaboratively with Warsaw-based orthopedics companies, indicates it is working with Indiana universities to build in more life science-oriented curriculum into mechanical engineering programs.
- **The skills and educational backgrounds required in the industry’s production workforce can vary significantly, often depending on the nature of the product and manufacturing.** A postsecondary certificate or even high school diploma combined with on-the-job training is acceptable in some areas of medical device manufacturing, while others require an associate’s degree and even prefer a bachelor’s degree or equivalent experience for more advanced production or leadership roles. Medical device firms such as Cook Medical and CRI, producing a wide array of single-use or minimally invasive disposables or related technologies, generally fall into the former category, while a company such as Roche Diagnostics, producing diabetes care test strips and other products, falls into the latter. Roche is actively seeking to upskill its production workforce and offers a generous tuition reimbursement program to incentivize workers to obtain a bachelor’s or advanced degree while working.
- **In the life sciences production workforce, there are significant concerns about the retirement risk to firms of an aging workforce.** In the orthopedics sector, acknowledging the “boom” hiring years during the 1980s, industry representatives raise concerns about the aging-out of this workforce and the experience and knowledge that will go with it. This phenomenon is not limited to the orthopedics industry. Acknowledging this issue and the need to address it within its engineering and production workforce, Roche is beginning to implement an early-in-career

¹⁶The Coalition of State Bioscience Institutes (CSBI), “Life Sciences Workforce Trends Report 2014.”

rotation program to integrate younger workers into the company through strategic rotations across the business.

The aging of the life sciences workforce is not only affecting the production side, but also gets raised with respect to top scientific talent. The makeup of much of Indiana's life sciences industry is among large, dominant firms across each subsector, a position envied by many other states and regions, but a situation that can create a dynamic where a relative lack of peer firms in similar lines of business leads to challenges in finding talent. Similarly, talented individuals may not see a clear career path to their next job or the next step in their career in the life sciences and thus, while there is a strong opportunity with an Indiana firm, they may look elsewhere toward a state or region where they see more opportunities.

The next section deals with the hospitals and health systems and their workforce demand dynamics, and then some key conclusions are drawn before turning to the supply side of the talent equation.

Hospitals and Health Systems Employer Survey Results and Interview Insights

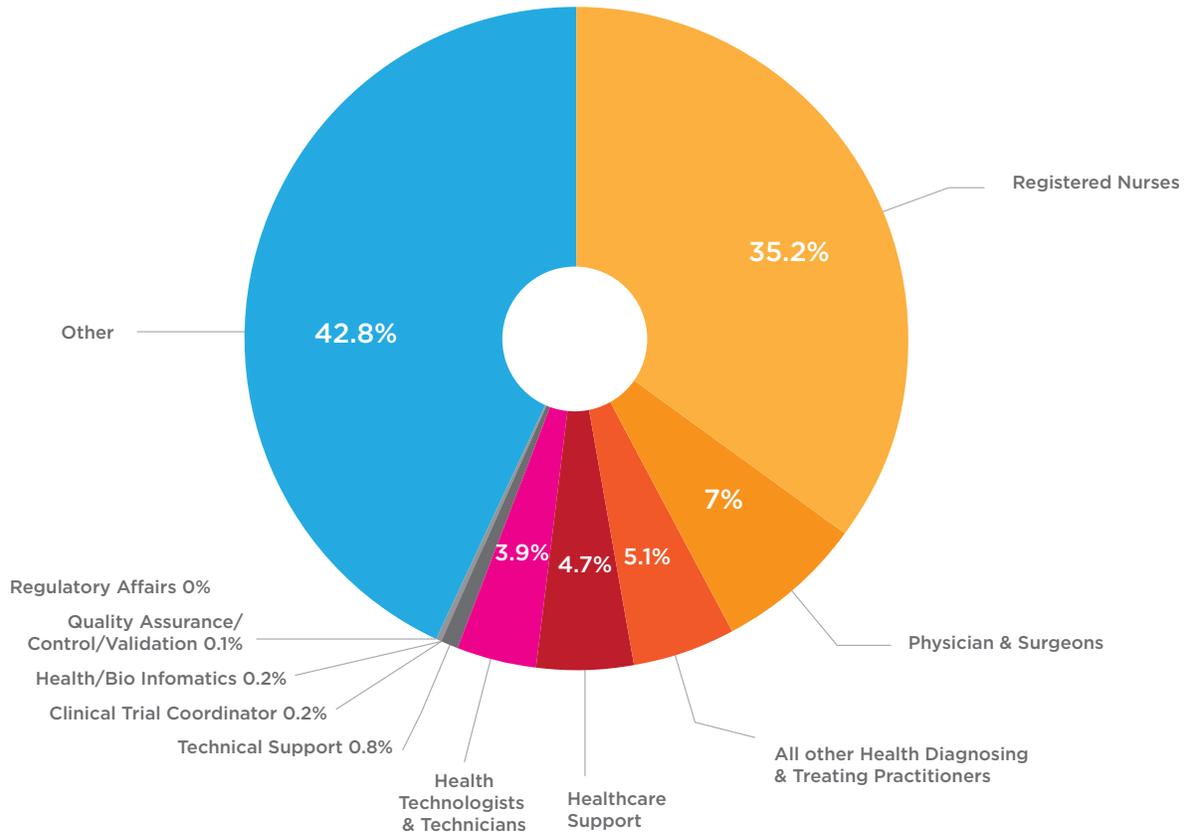
The interview, focus group, and survey interactions, guidance, and input from healthcare providers all come together to illuminate its own set of workforce demand dynamics and challenges. The healthcare workforce is unique in many respects. Employers more often draw from in-state talent that is more likely to be educated in Indiana and remain in state. Healthcare institutions are subject to strict licensing and practice rules and guidelines to ensure qualifications and patient safety, and the labor market is therefore more clearly defined but often limited in the talent from which it can draw. These same licensure requirements mean colleges and universities educating and training these workers cannot simply increase enrollment to adjust to employer demands and shifting requirements. Faculty must be hired, clinical placements must be available, and students must complete years of training, among other hurdles. The market for talent is therefore, by definition, slower to adjust.

Complicating these unique workforce dynamics are a series of shifts in the economics and other industry dynamics of healthcare. As a nation, we are moving toward a healthcare model focused on delivering measurably better, quality outcomes for patients as opposed to economic incentives directed toward simply providing more testing and health services. Hospitals are increasingly competing with outpatient and more "retail"-oriented services offered by drug stores and other retailers. Ever-increasing consolidation of hospitals has impacts on the distribution of talent across an expanding health system in a given state or region. Technology convergence is reshaping how patients access health services, as well as the flow and value of information.

Workforce surveys were completed by two major Indiana health systems that employ more than 32,000 across the state. While information on the current occupational makeup of these hospitals and their recent hiring was reported in a relatively comprehensive manner, survey items regarding current vacancies and expected new hires were in most cases incomplete. Given the robust nature of the core

occupational employment trends and projections presented earlier in this report, and the participation of hospitals and health systems on the Project Advisory Committee, interviews, and focus groups, the quantitative and qualitative perspectives combine to contribute a meaningful portrait of the labor market conditions in Indiana for healthcare (see Figure 14).

Figure 14: Occupational Employment Structure of Hospitals and Health Systems Responding to Survey



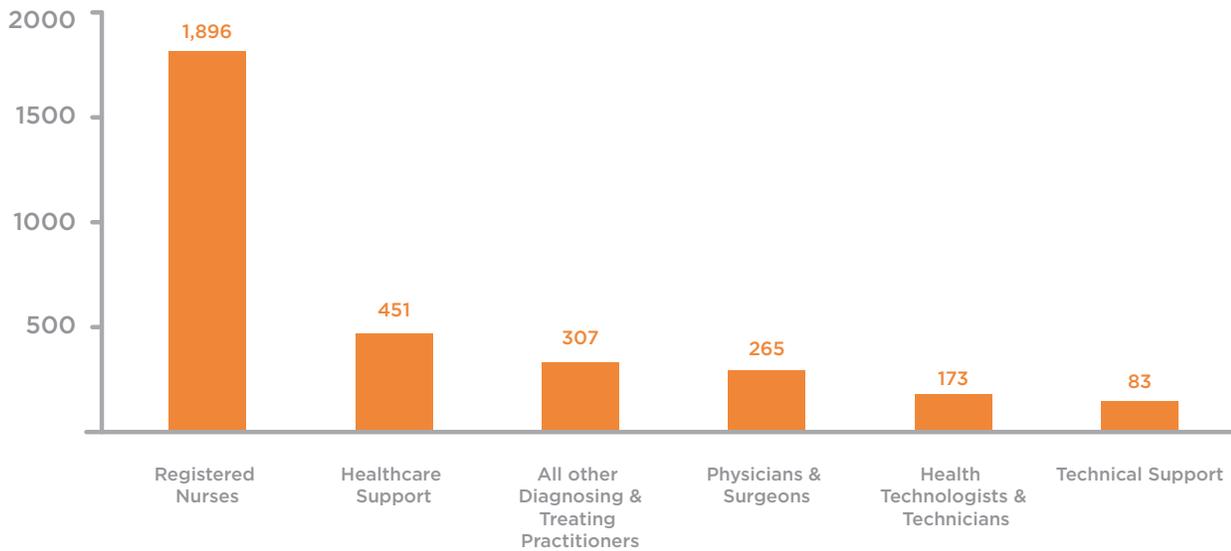
Source: TEconomy Indiana Life Sciences Workforce and Talent Survey, 2015. Note: not all responding firms reported occupational employment details. Health Technologists and Technicians includes Medical/Clinical Lab Techs; All Other Health Diagnosing group includes therapists, nurse practitioners, physician assistants, etc.; Healthcare Support includes nursing aides, orderlies, medical assistants, occupational/physical therapy assistants, etc.

Conversations with and information reported by Indiana’s hospitals and health systems support the high demand seen in the quantitative assessment in terms of both recent and expected hiring. As shown in Figure 15, in terms of recent hiring, the survey found especially high shares of recent hires relative to current employment base for the following:

- Technical support
- Healthcare support (nursing aides/assistants, orderlies, medical assistants, occupational/physical therapy assistants, etc.)

- All other health diagnosing and treating practitioners (including therapists, nurse practitioners, physician assistants, pharmacists, etc.)
- Registered nurses
- All other health technologists and technicians.

Figure 15: Recent Hires of Hospitals and Health Systems in the Last Year



Source: TEconomy Indiana Life Sciences Workforce and Talent Survey, 2015. Note: not all responding firms reported occupational employment details. Health Technologists and Technicians includes Medical/Clinical Lab Techs; All Other Health Diagnosing group includes therapists, nurse practitioners, physician assistants, etc.; Healthcare Support includes nursing aides, orderlies, medical assistants, occupational/physical therapy assistants, etc.

Registered nurses as a single occupation make up the largest share of the current healthcare workforce. While the hiring of nurses in Indiana has somewhat lagged the net growth rate for the U.S. since 2010, it has been made clear to TEconomy that the Indiana experience across all of nursing has been rather unique. Following the signing of the ACA in 2010, Indiana hospitals and health systems undertook a wave of nursing layoffs in a preemptive or “anticipatory” move citing declining admissions and lower reimbursements¹⁷ This, it turns out, was a misread of the potential impacts of the new legislation on the demand for health services and thus the need for nurses.

Today, Indiana employs more than 63,000 nurses across a range of practice areas and healthcare settings, of which more than 90 percent are registered nurses. The demand for nurses is extremely high, reaching a point of critical concern nationally and in Indiana when it comes to the ability to

¹⁷John Russell, “Retirements, aging population cause nursing shortage,” Indianapolis Business Journal, February 6, 2016.

continue to provide fully staffed hospitals and sufficient patient care. As mentioned previously, registered nurses are number 1 on the Hoosier Hot 50 jobs outlook list prepared by Indiana's DWD.

The extremely high expected demand for nurses now and into the foreseeable future reflects, in part, an aging workforce anticipating retirements in large numbers in the near future. The loss of experienced nurses exacerbates talent issues within a healthcare setting as years of accumulated knowledge and experience leave, and such retirements can affect critical care areas such as in pediatrics, in the emergency room, and in operating rooms where experienced nurses are especially needed.

The Center for the Advancement of Healthcare Professionals conducts regular surveys of nurses and, in its 2015 survey, confirmed the nursing shortage and declared the shortage is going to get worse.¹⁸ Key findings include the following:

- 62 percent of nurses over age 54 are considering retirement, and most plan to retire within 3 years
- 21 percent of nurses ages 54 and over say they plan to switch to part-time work
- 44 percent of nursing educators are considering retirement, limiting the ability to train future nurses.

In recent decades, nursing has undergone a shift toward more specialized and advanced credentials. In the U.S. depending on state regulations, advanced practice nurses such as nurse practitioners have roles relating to diagnosing and prescribing treatment. The educational requirements for nursing are changing following a call to action in 2010 by the Institute of Medicine (IOM) to increase the share of nurses with a bachelor's degree to 80 percent by 2020. The call to action by the IOM¹⁹ states as follows:

"Academic nurse leaders across all schools of nursing should work together to increase the proportion of nurses with a baccalaureate degree from 50 to 80 percent by 2020. These leaders should partner with education accrediting bodies, private and public funders, and employers to ensure funding, monitor progress, and increase the diversity of students to create a workforce prepared to meet the demands of diverse populations across the lifespan."

The Center for the Advancement of Healthcare Professionals survey found about half of all nurses are planning to pursue a higher degree, with a breakdown as follows:

¹⁸The Center for Advancement of Healthcare Professionals, 2015 Survey of Registered Nurses, see <http://www.amnhealthcare.com/2015-RNSurvey/>.

¹⁹Institute of Medicine of the National Academies, "The Future of Nursing: Focus on Education," Report Brief October 2010.

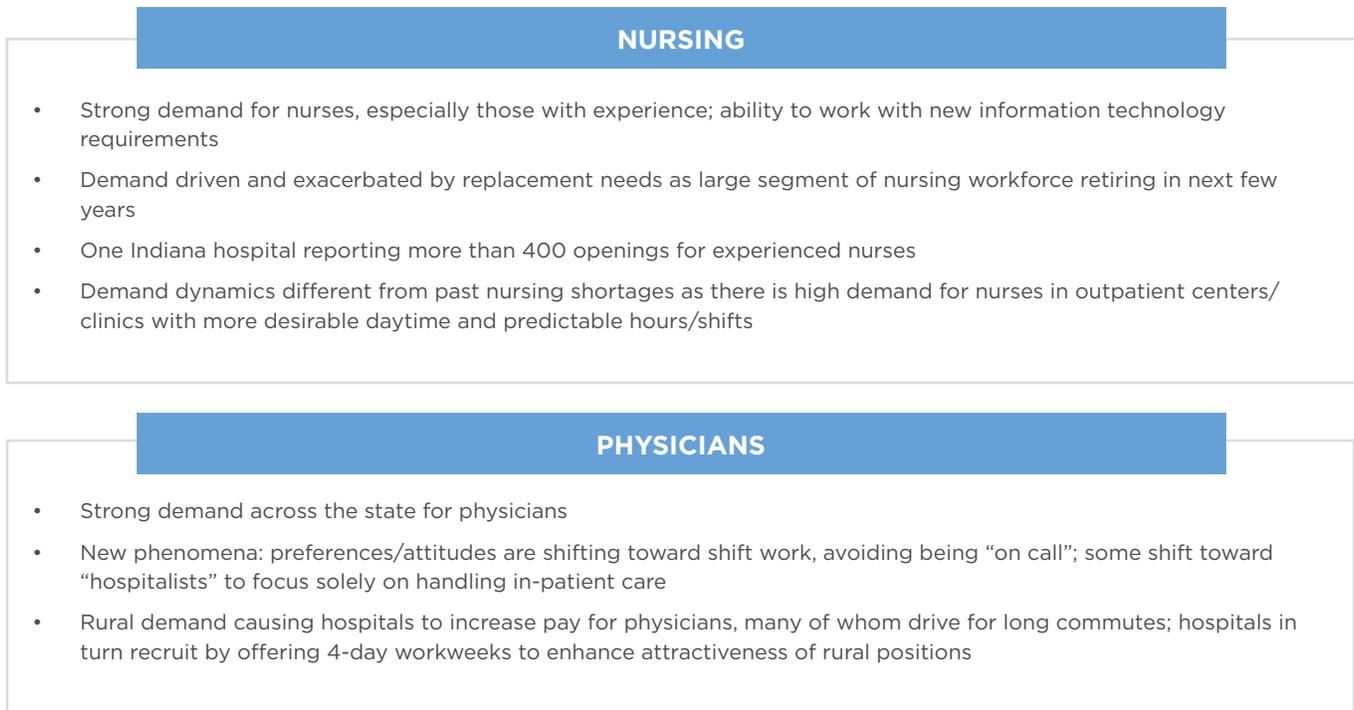
Nurses have a strong interest in pursuing higher education:

PLAN TO PURSUE IN NEXT 1-3 YEARS	SHARE OF RESPONDENTS
Bachelor's in Nursing	22%
Master's in Nursing	21%
Doctoral degree in Nursing	6%
Won't pursue further education	43%

Source: *The Center for Advancement of Healthcare Professionals, 2015 Survey of Registered Nurses.*

In discussions specific to Indiana's healthcare workforce conducted in one-on-one interviews and in a focus group, a number of dynamics, like those discussed above relative to nursing, were illuminated by hospital and health system leadership and spanned several occupational areas. These highlights and areas of emphasis are presented in Figure 16 regarding demand dynamics. A similar summary is included in the following section regarding the supply dynamics around healthcare workforce and talent.

Figure 16: High-Demand Occupations and Skill Sets and Related Dynamics Identified by Indiana Hospitals and Health Systems



OTHER HEALTHCARE OCCUPATIONS

- Demand for mental and behavioral health specialists, with very few psychiatrists in the state and graduating only a handful each year; related need for case management workers
- Health technologist/technician needs for lab workers; radiology techs; surgical techs; respiratory; new demands in lab techs related to genetic testing, counseling

INFORMATION TECHNOLOGY

- Very strong demand for IT workforce in hospitals—demand for candidates with bachelor’s level and above with communication and writing skills, ability to manage servers, create policies, manage projects, train/educate others
- Demand for IT workforce increasing due to implementation of Electronic Health Records and related systems such as EPIC, Cerner, others
- Rural hospitals report finding IT workers “almost impossible”

OTHER NON-CLINICAL OCCUPATIONS (BILLING, MEDICAL CODING, ETC.)

- High demand for ICD 10 medical coders
- Hospitals utilizing hundreds of “medical scribes” documenting work alongside physicians (likely a bridge job as physicians increasingly integrate IT systems, devices into practice)
- Medical billing specialists are in demand

GENERAL DEMAND DYNAMICS, CHALLENGES

- Shifts toward team-based healthcare delivery models have impacts for talent
- Demand for hospital workforce with training in Lean Manufacturing, Six Sigma, Healthcare Engineering to streamline operations, enhance team approaches, boost hospitality, and coordinate transitions/patient hand-offs
- Customer service an important and major new emphasis for hospital employees

Summary of Key Findings Related to the Demand for Health and Life Sciences Workforce

Demand can be summarized across both the quantitative and qualitative assessments, as shown in Table 3. Based on occupations receiving three or four stars across the various measures, occupational groups can be considered “high demand.”

Table 3: Summarizing the Demand Assessment

OCCUPATIONS	High-Growth (IN Gr.>US)	Projected High-Growth	Survey: Strong Recent Hiring	Survey: Strong Expected Hiring	Consistently Identified as in-demand in industry discussions	Total # of Stars
Health Diagnosing & Treating Practitioners	★	★	★	n/a	★	4
Health Technologists & Technicians		★	★	★		3
Healthcare Assistants & Support		★	★	n/a		2
Life Science-related Engineers	★		★	★	★	4
Life Science-related Technicians	★			★		2
Life Sciences Managers	★	★			★	3
Life Scientists	★	★			★	3
Nursing		★	★	n/a	★	3
Therapists		★		n/a		1
IT Occupations				★	★	2**
Skilled Industrial Production & Support	★			★	★	3
Technical Support*	n/a	n/a	★			1
Health, Bio-informatics*	n/a	n/a	★		★	2**
Clinical Trial Coordinator*	n/a	n/a	★	★	★	3
Marketing & Sales*	n/a	n/a		★		1

* Indicates occupational groups not included in occupational analysis due to limitations in the occupational classification system. These occupations were included in the industry survey.

Projected High-Growth Occupations are those whose 10-year projected growth rate exceeds that for the overall Indiana economy. Strong Recent Hires are those where recent hiring was above-average relative to the employment base reported. Strong Expected Hiring occurred where expectations are to hire an above-average share of workers relative to their employment base.

** Based on the near-universal expression of intense demand for both health/bioinformatics and broader IT professionals by Indiana companies, this occupation has been designated in the high-demand group. While IT employment has not outpaced the rapid growth across the country, it has grown by double digits since 2010. This also reflects limitations on isolating IT occupations solely within the life sciences, where there is very strong demand that may in fact be outpacing needs in other sectors. The healthcare sector has indicated strong, steady demand for medical informatics.

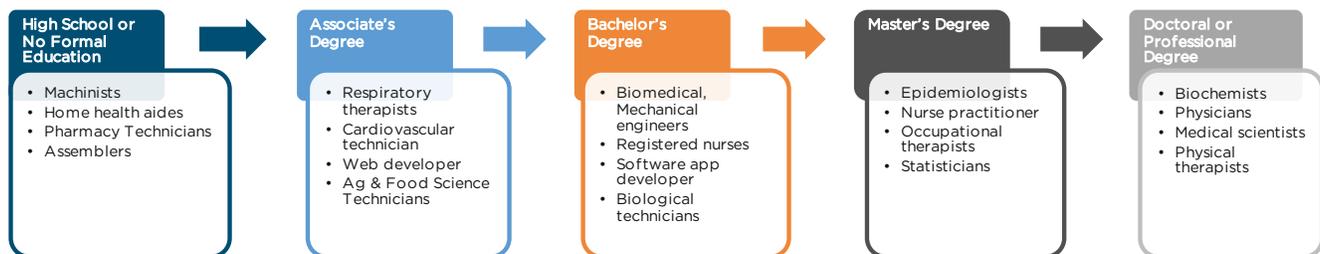
Supply of Health and Life Sciences Talent: What talent supply and capacity does Indiana have now?

Indiana’s health and life sciences industry has an established demand for workers across an industry that has grown its employment base in the state by 15 percent since 2001, with thousands of job openings expected each year across a wide array of skill needs.

These demands will be exacerbated by an aging workforce, particularly in key areas of industrial production, leading areas of science, and core health services functions, including nursing. Innovation-led industry clusters like the life sciences compete on the ability to educate, train, recruit, and retain a specialized workforce that meets the needs of the local sector. In examining the market for health and life sciences talent in Indiana, it is important to understand the state’s ability to develop and recruit this workforce, and the challenges and gaps seen by employers in carrying this out. Once established, the supply of workers can be held up against demand to assess the balance for a whole range of occupations and skill sets.

The health and life sciences industry requires a diverse and predictable supply of skilled workers across the educational spectrum, as well as blended experience and on-the-job training requirements for different occupations. The U.S. Bureau of Labor Statistics (BLS) has a system in place to assign typical entry-level requirements for educational attainment, experience, and on-the-job training for each occupation (see Figure 17).²⁰

Figure 17: Examples of Educational Requirements to Enter Health and Life Sciences Occupations



Source: U.S. Bureau of Labor Statistics, Occupational Projections Program.

²⁰For more information on this system and the classifications, visit the BLS Employment Projections website at http://www.bls.gov/emp/ep_education_tech.htm.

To assess the educational requirements across the occupational groups, the TEconomy surveyed Indiana health and life sciences employers to learn about minimum educational requirements for entry-level positions in each group. The responses are summarized in Table 4. While these responses show some dispersion for several of the occupations where requirements are mixed, the minimum requirements do align well with those set by the BLS at the national level.

Table 4: Typical Minimum Entry-level Educational Requirements by Health and Life Sciences Occupational Group Based on Survey of Indiana Employers

OCCUPATIONAL GROUPS	No Diploma	High School Diploma	Vocational Training, Certificate	Associate's	Bachelor's	Master's	PhD or MD
Manufacturing & Production		✓		✓	✓		
Healthcare Support	✓	✓	✓	✓	✓		
Other Health Technologists/ Technicians			✓	✓	✓		
Medical/Clinical Lab Technicians				✓	✓		
Research Technicians				✓	✓		
Engineering Technicians				✓	✓		
Technical Support				✓	✓		
Registered Nurses				✓	✓	✓	
Regulatory Affairs					✓	✓	
Marketing & Sales					✓	✓	
Quality Assurance/Control/ Validation				✓	✓		
Engineering					✓	✓	
Clinical Trial Coordinator					✓	✓	✓
Health/Bio-Informatics					✓	✓	
Research Scientists					✓	✓	✓
All Other Health Diagnosing & Treating						✓	
Physicians & Surgeons							✓

✓ = first-tier degree requirements
(3 or more companies selecting degree level)

✓ = second-tier degree requirements
(1-2 companies selecting).

Assessing Supply: The Pool of Indiana Graduates

While Indiana companies often recruit throughout the Midwest and across the nation, the primary talent pool from which Indiana employers draw is in-state postsecondary institutions. The supply assessment presented here focuses primarily on the graduation totals and trends of in-state institutions, and while health and life sciences employers hire a mix of both new graduates and experienced workers, these data on recent graduates serve as a surrogate indicator for available talent and a critical indicator of the current talent pipeline that Indiana has in place to supply the life sciences and other advanced industries with high-skilled talent. Further, in order to be considered a qualified candidate with an advanced degree and sufficient job experience, a college degree in certain disciplines is required. If the supply of persons with this initial degree is limited, there is no opportunity to achieve an advanced degree or the next set of education and skills requirements.

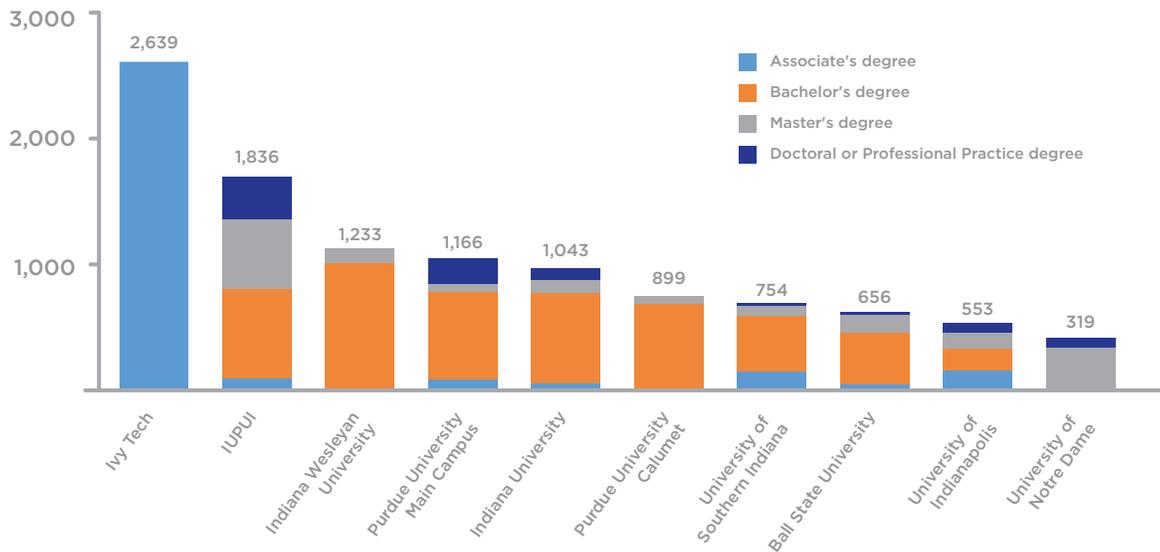
Indiana's public and private institutions of higher education are a valuable resource to the state, and one that sets Indiana apart from other states. **In fact, students from across the U.S. and from around the world come to Indiana to study and to earn a degree; this influx of students, in turn, increases the talent pool that can be retained to grow Indiana's economy.** Indiana is in the middle among states in terms of its percentage of all undergraduate students who come to school from out of state—24 percent in 2014 were from out of state, ranking 22nd among all states. However, if one ranks states by the sheer size of this out-of-state cohort, Indiana ranks 11th, with the migration of undergraduate students into Indiana totaling 16,583 in the Fall of 2014.²¹ Analysis among individual institutions for the 2013-14 academic year shows Indiana University-Bloomington having the third-highest number of out-of-state undergraduate students among all 4-year schools nationwide with at least 2,000 students and Purdue University having the third-highest number of first-year foreign undergraduate students.²²

The in-state institutions educating and preparing these graduates for work are varied, representing both public and private colleges and universities with varying degree levels, programs, and focus areas. Some of the top institutions in broad health and life sciences degree fields in Indiana are shown in Figure 18 by degree level.

²¹U.S. Department of Education, National Center for Education Statistics, *Integrated Postsecondary Education Data System (IPEDS), Spring 2015, Fall Enrollment component*. Accessed via the *Digest of Education Statistics*. Data represent residence and migration of all first-time degree/certificate-seeking undergraduates in degree-granting postsecondary institutions in Fall 2014. Student in-migrant totals include foreign students.

²²Institute of Education Sciences, U.S. Department of Education, analysis developed and presented by Valore Books, see http://www.valorebooks.com/visualizing-college-out-of-state?pd=_.

Figure 18: Indiana Institutions by Health and Life Sciences-related Degree Graduates and Level, 2014

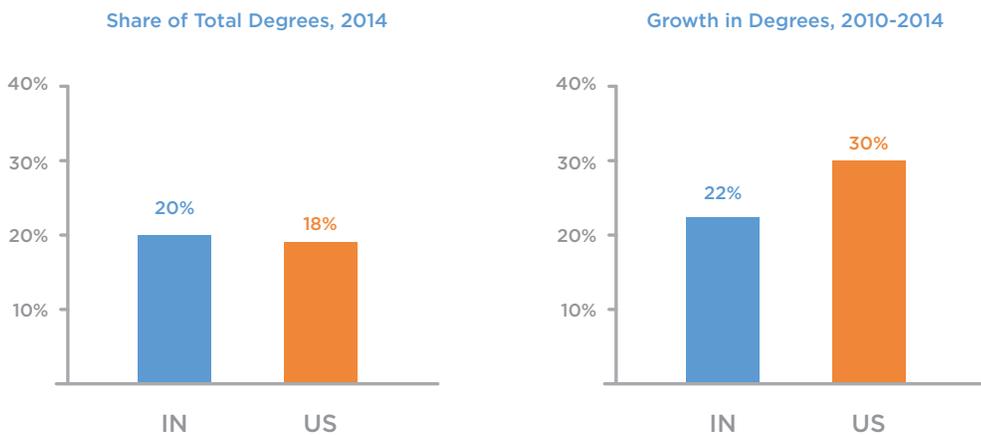


Note major degree categories include: Biological and Biomedical Sciences; Health Professions and Related Programs.

Source: TEconomy analysis of National Center for Education Statistics, IPEDS Database.

Indiana is graduating a higher concentration in overall health and life sciences-related fields compared with the nation, but the growth in these fields has been slower in recent years (see Figure 19). Indiana is slightly ahead of the nation in the share of its postsecondary degrees awarded in health and life sciences fields. Still, Indiana is not keeping pace with the strong growth nationally, and thus risks falling behind.

Figure 19: Postsecondary Degree Graduates, Associate’s and Higher, in Health and Life Sciences-related Fields, 2014, and Growth 2010-14



Note major degree categories include: Biological and Biomedical Sciences; Health Professions and Related Programs.

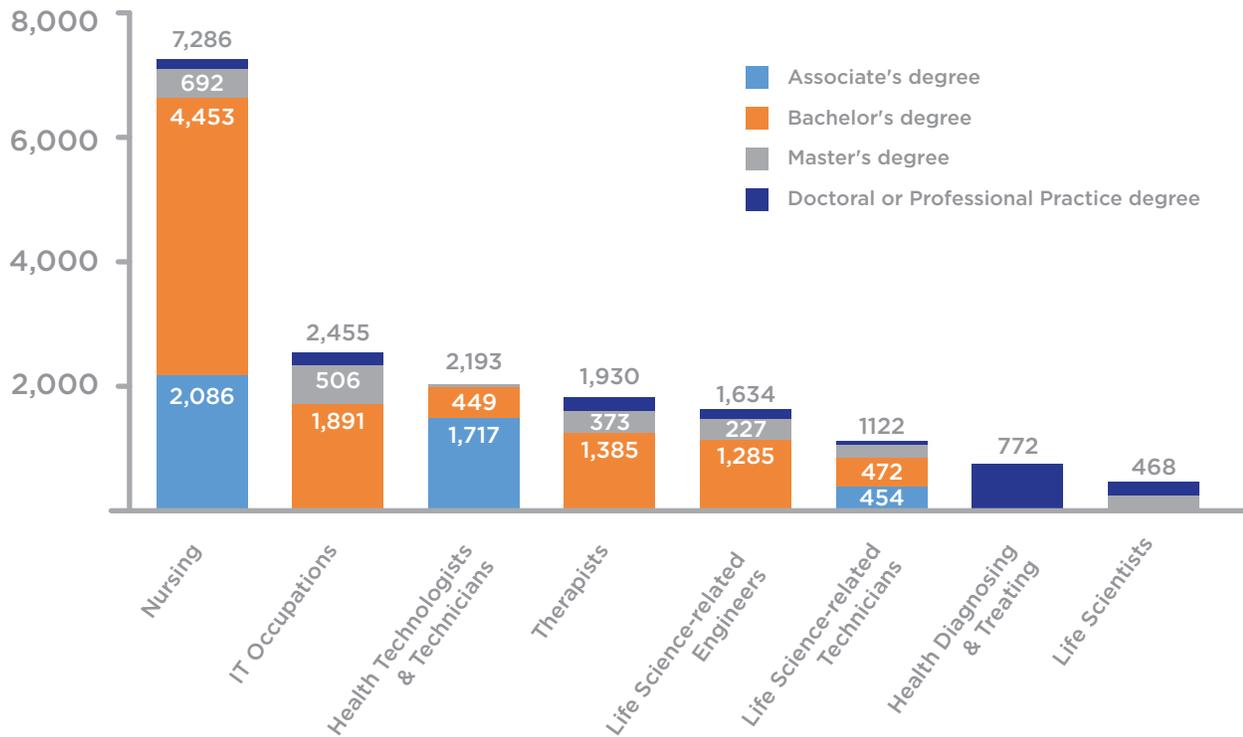
Source: TEconomy analysis of National Center for Education Statistics, IPEDS Database.

A more refined level of analysis of the specific degrees generally required for each of the health and life sciences occupational groups finds that graduates of Indiana’s higher education institutions are growing across nearly all of these degree fields. A crosswalk analysis of health and life sciences occupations to degree fields is available from the U.S. Department of Labor-funded National Crosswalk Service Center operated by the State of Iowa. The crosswalk assigns those disciplines most directly relevant to each job at a detailed level. While one must acknowledge that there are numerous employed individuals who work in jobs not directly related to their college major/discipline, this is a useful way to gauge the specialized areas taught at Indiana colleges and universities that most closely and directly relate to areas of required expertise by the health and life sciences industry.

Some of the leading examples of Indiana degree programs included in each category are listed below, and Figure 20 shows the overall level of degrees associated with specific health and life sciences occupations:

- **Health Diagnosing and Treating:** Medicine, Pharmacy, Dentistry, Optometry
- **Health Technologists and Technicians:** Veterinary/Animal Health Tech, Surgical Technology/Technologist, Radiologic Technology/Science—Radiographer
- **IT Occupations:** Computer Science, Informatics, Management Information Systems; Computer and Information Sciences
- **Life Sciences-related Engineers:** Mechanical Engineering, Industrial Engineering, Bioengineering and Biomedical Engineering
- **Life Sciences-related Technicians:** Industrial Technology, Mechanical Engineering/Mechanical Technology, Biology Technician/Biotechnology Lab Tech
- **Life Scientists:** Biology/Biological Sciences, Cell Physiology, Soil Science and Agronomy, Biochemistry
- **Nursing:** Registered Nursing, Family Practice Nurse, Nursing Administration
- **Therapists:** Kinesiology and Exercise Science, Audiology and Speech-Language Pathology, Occupational Therapy.

Figure 20: Indiana Postsecondary Degree Graduates in Fields Most Aligned with Health and Life Sciences-related Occupations, 2014



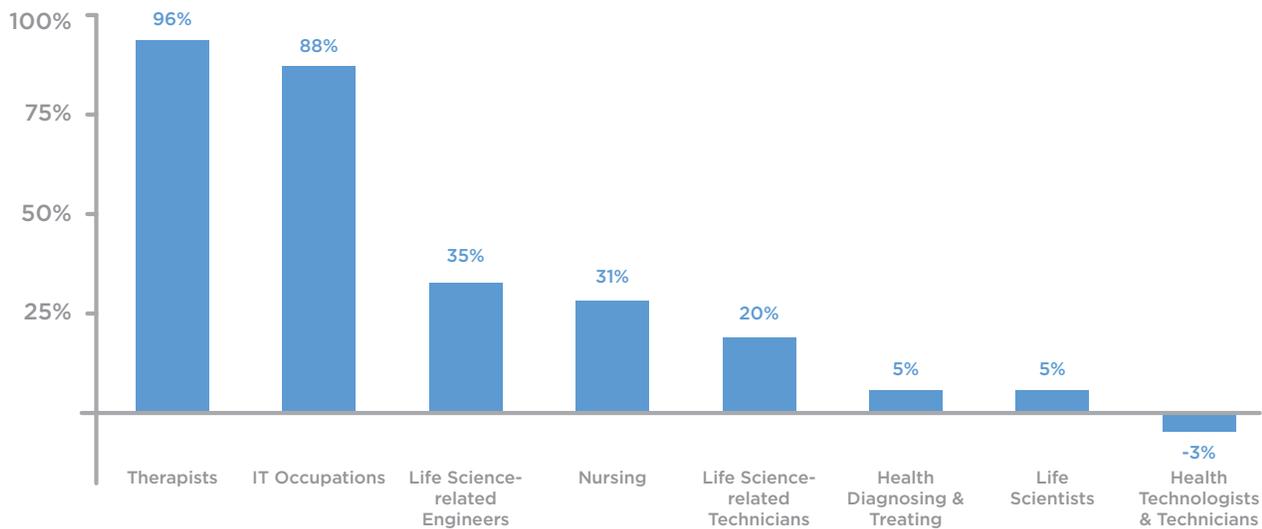
Degree graduate totals align with levels of degree generally required. Occupation to Degrees crosswalk developed by the National Crosswalk Service Center.

Data not shown for: Management occupations due to inability of crosswalk to effectively map degrees to “managers”; and Health-care Assistants/Support and Skilled Industrial Production as majority of jobs do not require postsecondary education for entry.

Source: TEconomy analysis of Postsecondary Degree data from National Center for Education Statistics, IPEDS Database.

Indiana is recording growth across nearly all of these degree fields associated with specific health and life sciences occupations. As shown in Figure 21, some degree fields such as therapy and IT are growing at very high rates. Indiana institutions and student interest and demand are clearly lifting degree graduates in high-demand health and life sciences areas including nursing. This increase in nursing graduates is particularly remarkable given the size of the nursing degree pool and reflective of the more stringent educational requirements driving employed nurses back into classrooms. High growth in engineering is similarly impressive, as the state has an existing large base of engineering degree programs.

Figure 21: Change in Indiana Graduates in Fields Most Aligned with Health and Life Sciences-related Occupations, 2010-14



It is important to recognize that not all degree programs are created or designed alike and that the educational paths associated with specific careers and occupations can differ greatly. Many students pursuing careers as scientists or engineers enroll in undergraduate studies with plans to spend years in graduate schools; others might have an existing undergraduate degree in a scientific field, or even in liberal arts, and decide to enroll in an applied master’s or postbaccalaureate program in a technical field of study or to develop or hone lab skills. Careers in health fields can require varied degree levels but also time in the clinic and with patients, or even in a simulated healthcare environment, to earn credentials. Further, life sciences companies also require pools of talent in sales, staff, and support positions; so, overall graduation levels in liberal arts and business programs are important to the growth of Indiana’s life sciences industry as well.

Nearly all of Indiana’s colleges and universities play some role in the development of the state’s health and life sciences workforce. Here are some specific examples of niche programs or unique partnerships that have been highlighted through the course of this study. Discussions with industry human resources and other executives reveal a preference for certain educational programming structures (often very “applied” in design) and areas of focus, many of which have a blended approach of time in the classroom with hands-on experiences. Industry-university partnerships play a key role in program design, including accommodating work schedules, and in accelerating training for working professionals or in high-demand areas such as nursing. Industry representatives and scientists indicate they are often brought in to assist in designing educational curriculum. For example, representatives of Dow AgroSciences are part of the regional industry advisory boards for Ivy Tech, and others collaborate with Indiana University on business and life sciences programs and with Purdue University at Discovery Park.

Some examples of these effective, applied programs with industry partners have been shared during the course of this study (with further information included in the recommendations section below) and include: Grace College Orthopedic Regulatory and Clinical Affairs (ORCA); Grace College Medical Device Quality Management; Ivy Tech Community College Orthopedic Quality Standards and Technical Skills Certification; Ivy Tech Community College-Bloomington Biotechnology Program; and industry-university collaborations in nursing education, including Marian University for the St. Vincent Health Accelerated Nursing Program, and Community Health Nursing Academy at Ball State University.

In addition to the specific examples provided above, Indiana’s strong public and private university base plays a major role in developing the health and life sciences workforce. Employer feedback praises these institutions as a major strength for enabling business in Indiana. Indiana University’s Schools of Medicine, Business, and Informatics and Computing are recognized as key assets for the health and life sciences industry; Purdue University is a national leader in engineering technology and plays a key role in supplying engineering as well as agricultural talent across Indiana and the world; the University of Notre Dame provides a significant pipeline into medical schools in Indiana and throughout the country and is investing in drug discovery and other biomedical research. Ivy Tech plays a leading role in educating and training nurses and the healthcare technician workforce, and hospitals have found Ivy Tech to be very responsive to addressing nursing shortages in Indiana.

Assessing Supply: Employer Survey Results and Interview Insights

Industrial life sciences employers have shared views on the supply and training of specific occupations and have emphasized areas of need in terms of technical as well as “soft” skills training for both new job candidates and incumbent workers.

- Employers note certain specialty areas of expertise are often not taught in educational institutions. Industrial life sciences employers cite regulatory sciences/affairs as a prime example of a competency that is not a formal academic discipline and must instead be learned on the job.
- Regarding the challenges of identifying or developing individuals with cross-functional and multidisciplinary competencies, employers indicate that they are more likely to bring along an employee with a background in a technical or scientific discipline and to work to develop that employee’s business-related acumen and skill sets, rather than vice versa.

A range of more general, and often less technical and even “soft” skill sets are cited by employers as critical “emerging” areas of importance in developing their incumbent workforce. These areas for potential training needs include the following:

- Understanding how to manage and lead millennials;
- Managing and leading/adapting through change;
- Savvy with digital and social media;
- Government affairs/advocacy;
- Media skills/public speaking skills;
- Business, interpersonal, and communication skills;
- Solution/consultative selling;
- Project management;
- Critical and strategic thinking; and
- Financial management acumen.

For less-experienced workers or job candidates, industrial life sciences companies are looking for technical skill sets in math, data analysis, statistics, and experience in a lab setting with industry-relevant equipment and technologies. With respect to more soft skills, employers are looking for characteristics such as curiosity; being a quick learner; and listening, writing, and strong communication and overall interpersonal skills.

In the employer survey, respondents were asked to indicate **the emerging life sciences-related technology areas they expect to see in the next 5 years that need to be reflected or emphasized in today’s educational curriculum.** These technology areas recognized by industry as important, and listed in descending order of those most-often mentioned, include the following:

- Bioinformatics
- Precision medicine
- Connected/digital health including remote monitoring
- Biomarkers
- Synthetic biology
- Regenerative medicine and other stem cell therapies
- Precision agriculture
- Plant and seed genetics/genomics
- Biomaterials
- Biofuels and other bio-energy technologies
- Other areas noted: sales and marketing around sequencing; chemistry including crop protection, computational, protein; digital and social media skills for marketing.

In terms of potential training, workshops, or seminars to offer their existing, incumbent workers, employers viewed the following areas as most valuable:

- U.S. Food and Drug Administration (FDA) regulatory approval processes for new products
- Clinical trials management
- Bioinformatic standards and concepts
- GMP.

These areas of emphasis among Indiana employers highlight not just the types of cutting-edge technology skills and knowledge needed in today's life sciences industry, but also the types of interpersonal and soft skills they expect in qualified, well-rounded employees.

Representatives of Indiana's hospitals and health systems through the survey, interviews, and focus groups also shared key input regarding the supply side of the healthcare workforce dynamics they face. Similar to the demand side, their challenges relate to shifting economic models and service delivery approaches with implications for workforce as well as workforce-specific challenges.

Similar to the recruiting situation for the non-hospital companies, health systems indicate that they recruit from varied geography. National recruiting, not surprisingly, is undertaken with a focus on higher-educated, higher-skilled jobs for physicians and surgeons, research scientists, health and bioinformatics, regulatory affairs, quality assurance, and even registered nurses. State and local recruiting is geared more toward technician workforce, technical support, and healthcare support positions.

While the educational requirements, degree graduates, and postsecondary partnership programs have been outlined for hospitals and health systems previously in this section, it is important to relate the qualitative takeaways from discussions with Indiana's hospitals and health systems (see Figure 22).

Some key overview points cited with respect to challenges with the supply of healthcare workers:

- There are real limitations to developing this workforce due to limited numbers of clinical sites, training staff, and rotations.
 - Simulation training is one solution largely viewed as effective, but it cannot fully replace training in a live clinical setting.
 - Capacity for training/educating physicians will improve, as the new Marian University College of Osteopathic Medicine (MU-COM) began accepting students 2 years ago.

- Hospitals emphasize the importance of making sure physicians, nurse practitioners, and physicians assistants are working at the “top of their license,” meaning that they are not limited or hamstrung by excessive rules and regulations.
 - When health systems are constrained in talent supply in a 24:7 care environment, these high-skilled individuals are needed to practice in full and hospitals are looking to PAs and NPs to deliver primary care.
- Hospitals are increasingly emphasizing customer service, soft skills, and training as they face more competition in the marketplace from retail clinics.

With respect to training, workshops, and seminars for existing employees, hospitals and health systems indicated the following topics would be valuable:

- Electronic medical records
- Clinical trials management
- Bioinformatic standards and concepts.

Dynamics and viewpoints regarding specific occupational groups are indicated in Figure 22.

Figure 22: Talent Supply Dynamics for High-Demand Occupations and Skill Sets Identified by Indiana Hospitals and Health Systems

NURSING

- Shift in educational requirements for nursing: recommended now for RNs to work toward a BSN degree (increased requirement from more traditional ASN)
- Increasing education requirements for nurses being supported by employers and schools (tuition reimbursement, flexible online courses, schools making it easier for working professionals)
- Master's level increasingly important for clinical nurse specialist, clinical informatics, infection control specialist roles
- Role of Indiana institutions especially important as vast majority of Indiana nurses educated in the state
- National reports indicate about 30% of nurses will be retiring over next few years; this dynamic exists in Indiana
- Cutbacks in nursing occurred around 2010 with signing and early implementation of national ACA legislation— "anticipatory layoffs" in Indiana; these jobs have come back, but nurses became more mobile as a result, and many left Indiana
- Need to build in RN Residency programs, invest in training to hire new grads
- Increasing use of simulation in nursing education/training to get around clinical capacity limits; generally seen as effective; also has a role in honing skill sets for experienced nurses, boosting teamwork
- Nursing leadership indicate they tend to "grow our own," meaning mentoring, training younger, less-experienced nurses on the job

PHYSICIANS

- Physician pipeline expected to improve with second Indiana medical school, MU-COM, opening in 2013; first cohorts now entering residency
- Indiana hospitals working with state legislature to increase residency slots

INFORMATION TECHNOLOGY

- Unlike clinical workforce, employers face significant turnover among IT workers
- Training timelines on hospital systems and unique requirements are long, taking a year in some cases to train an IT worker

OTHER NON-CLINICAL OCCUPATIONS (BILLING, MEDICAL CODING, ETC.)

- Need for increased, current training in new ICD 10 medical coding; can take 6 months to get certified; hospitals currently seeding this workforce "in house"
- Medical billing courses, programs non-existent
- Lack of awareness of these career opportunities in K-12 schools; not an area that students, early-career individuals are considering

GENERAL DEMAND DYNAMICS, CHALLENGES

- Major challenge in growing range of clinical professions is to increase access to clinical sites and rotations
- One obstacle to training new or existing employees or students is scarcity of faculty for training; hospitals often have to supplement staff income to incentivize training; this has led to increasing use of simulation to train healthcare providers

Key Findings Regarding Supply of Talent

It is evident Indiana's colleges and universities are producing large numbers of degree graduates in core health and life sciences disciplines, as evidenced by an above-average concentration of these degrees relative to the country. Of further importance, as the state industry is generating high demand for workers with these degrees and technical knowledge, Indiana's higher education institutions are increasing the levels of graduates both broadly and in specific key degree areas such as IT, engineering, and nursing.

Key findings from the analysis of talent supply include the following:

- Indiana has an above-average concentration of health and life sciences degree graduates relative to the nation, and the numbers of these graduates have increased in recent years, but not as fast as for the U.S.
- A qualified health and life sciences workforce requires large numbers of highly educated workers spanning several levels of attainment, a finding that is reinforced by employer feedback regarding degree requirements.
- Degree graduates in fields most closely aligned with the health and life sciences occupational groups are growing since 2010, many at very high rates, which is a positive signal in meeting industry job demands.
- In addition to Indiana's broad strengths in higher education as recognized by employers, industry is partnering with universities to develop applied programs that emphasize specific technical talent needs in the life sciences and are unique in their blend of work in the classroom with hands-on work in the field.
- In the big picture, industry stakeholders must work to engage students during their studies in internships, mentoring programs, etc., to show students viable career opportunities in the health and life sciences in Indiana as a strategy to improve retention rates of graduates in state.

Progress is evident from the supply side of the life sciences talent equation, but is this enough to meet high demand given the attrition Indiana experiences with students post graduation? Even with a robust pipeline of recent graduates, are their skill sets and experience level able to meet the needs of industry? The next section looks to align key findings regarding demand with supply and to understand where the equation is in balance, and where imbalances are evident and need to be addressed.

Aligning Demand with Supply: What are the major gaps?

To ensure the health and life sciences industry in Indiana can continue to thrive, the demand and supply sides of the equation must balance as best as possible. While there are likely to always be specific challenges for individual companies or with respect to individual job openings as skill needs shift or particular fields grow or contract, identifying the significant gaps or imbalances in the demand-supply equation can help to address the overall issue.

One approach to assessing potential gaps for workers in health and life sciences occupations is to directly relate the projected levels of demand against the annual graduate supply generated by state institutions. One must recognize the significant caveats associated with this approach, namely, the expected attrition of graduates out of state following graduation is unaccounted for; individuals do not always enter a line of work directly related to their degree discipline; and recent graduates do not have the experience required for certain job openings, particularly when needed to replace retiring workers. Those caveats acknowledged, the assessment, at a high level, can immediately point to imbalances where the supply of recent graduates does not meet or exceed annual needs.

One adjustment can be made to this approach, however, with respect to assessing graduate “retention.” Of course, not all graduates of any state’s postsecondary institutions are going to remain in state to begin (or continue) their careers. Indiana’s position as a net importer of students to attend its colleges and universities will tend to see a loss of graduates to other places if for no other reason than many of these students are returning to the states or countries from which they originally came. But some assessment and calculation of career prospects or continuing education is considered by virtually all graduates, including consideration of wages/salary. Coming to Indiana to study for some number of years provides even out-of-state students with exposure to what life can be like in the state as well as the opportunity to evaluate career opportunities in Indiana companies and across industries.

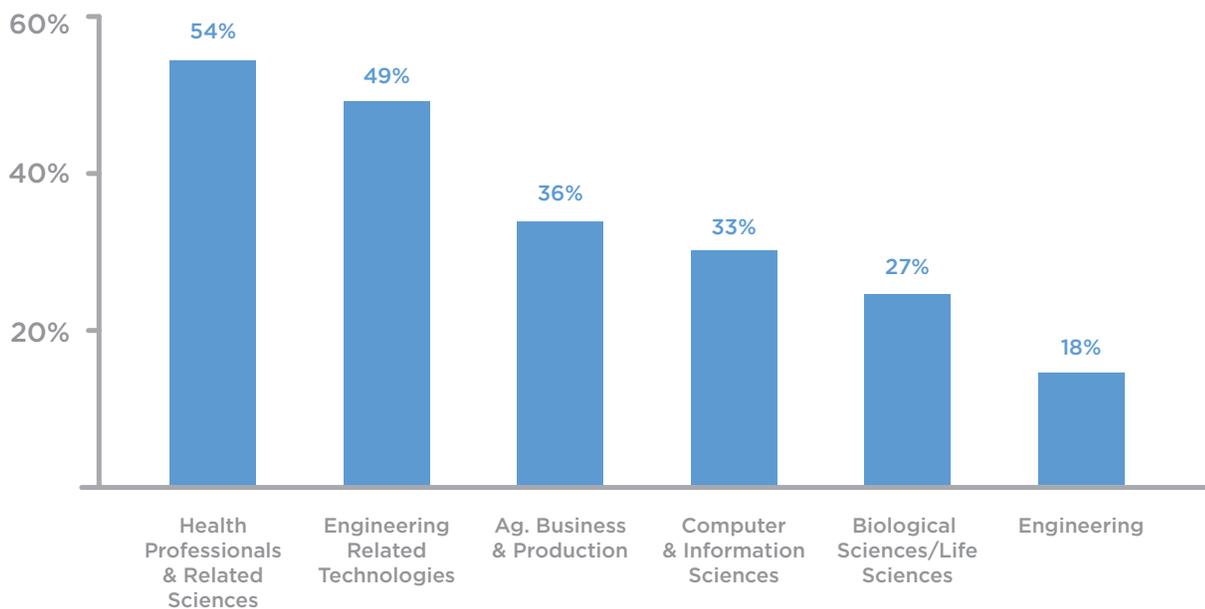
Indiana, like some other states, has been innovative in its linkages of state-level education and workforce databases to enable some tracking of students attending its public colleges and universities to determine whether or not they are employed in the state following graduation, based on personal

identifying information such as social security numbers and/or driver's license numbers. These data are maintained under the Indiana Network of Knowledge (INK) program.

Data from INK were provided to TEconomy to understand the retention context for graduate cohorts across high-level degree programs. Figure 23 shows the shares of public institution graduates employed in the state in 2014.

Comparisons of these types of graduate “retention” data are very difficult to make, mainly due to limitations of obtaining these data from the other states that develop them, the lack of a national average for comparison, and Indiana’s unusually strong position in attracting students from outside its borders to study. With that said, the data reveal that, among graduates from 2009–13, the state retained 18 percent of its engineering graduates in employment, and 27 percent of life sciences graduates. Health professions and related areas do better in retention, a finding that was also anecdotally related to the project team.

Figure 23: Share of 2009–13 Graduates at the Bachelor’s Level and Above from Indiana Public Institutions Employed in Indiana in 2014



Source: TEconomy analysis of data provided by the Indiana Network of Knowledge (INK) via the Indiana Department of Workforce Development. Note some graduate and employment totals are suppressed by INK due to limited sample sizes and to maintain confidentiality.

Digging still further, the INK data reveal stark realities in both graduate retention rates and overall makeup of students in terms of residency. The imbalance between in-state and out-of-state students is particularly high in engineering, where two-thirds of the graduates from public universities in

Indiana are from out of state and only one-third are native Hoosiers. In IT (computer sciences) programs, nearly 4 in 10 graduates are from out of state. By comparison, among all other (non-engineering and non-IT) degree fields related to health and life sciences, roughly 80 percent of the graduates are from in state. As one would expect, this enrollment structure can create challenging dynamics for graduate retention in Indiana.

Currently, the level of retention for key science, engineering, and IT graduates is quite low, even among in-state residents (see Table 6). Among graduates from 2009 to 2013 across Indiana’s public colleges and universities:

- Only 33 percent of in-state biological science graduates, and 6 percent of out-of-state graduates, work in Indiana;
- Only 38 percent of in-state engineering graduates, and 6 percent of out-of-state graduates, work in Indiana;
- Only 49 percent of in-state computer and information sciences graduates, and 5 percent of out-of-state graduates, work in Indiana.

By comparison, in the healthcare degree fields, more than 60 percent of in-state graduates and closer to 10 percent of out-of-state graduates work in Indiana.

As a result, aggressive efforts to retain talent needs to be a priority for Indiana. These data have implications for strategic interventions going forward, including potential goals of both increasing the enrollment and graduation of native Hoosiers as well as working to retain a greater share of those out-of-state students attending state schools.

Table 6: Share of 2009–13 Graduates at the Bachelor’s Level and Above from Indiana Public Institutions Employed in Indiana in 2014, by Residency Status

KEY DEGREE FIELDS	Total All Residency	In-State	Out-of-State
	Share Employed, 2014		
Health Professions & Related Sciences	54%	64%	9%
Engineering-Related Technologies	49%	61%	8%
Agricultural Business & Production	36%	50%	1%
Computer & Information Sciences	33%	49%	5%
Biological Sciences/Life Sciences	27%	33%	6%
Engineering	18%	38%	6%

Source: TEconomy analysis of data provided by the Indiana Network of Knowledge (INK) via the Indiana Department of Workforce Development. Note some graduate and employment totals are suppressed by INK due to limited sample sizes and to maintain confidentiality.

Tables 7 and 8 utilize the demand-supply assessment approach described above under two frameworks:

1. First, assessing demand based on expected annual job openings and comparing this number with total graduates of the most directly relevant Indiana degree programs; and
2. Second, assessing the same annual job openings compared with graduate totals where the average retention rates of the degree programs are applied to provide a more realistic picture of the expected hiring pool adjusted for retention.

Table 7: Approach #1, Indiana Life Sciences-related Occupations: Comparison of Annual Projected Job Openings vs. “Supply” of Total New Higher-Education Degrees Generated

KEY HEALTH & LIFE SCIENCES OCCUPATIONAL GROUPS	Indiana Projected Annual Job Openings, 2012-22	Indiana Degree Graduates	“Difference [“+” = More Degr Grads; “-” = Fewer Grads than Openings]”	Degree Levels Generally Required
Healthcare Assistants & Support	3,517	n/a	n/a	<i>High School or Some Postsecondary Credential</i>
Health Technologists & Technicians	2,842	2,193	-649	<i>Associate's and Higher</i>
Nursing	2,375	n/a	n/a	<i>Associate's and Higher</i>
IT Occupations	1,330	2,455	1,125	<i>Bachelor's and Higher</i>
Health Diagnosing & Treating Practitioners	1,187	772	-415	<i>Doctoral or Professional Degree</i>
Life Science-related Engineers	769	1,634	865	<i>Bachelor's and Higher</i>
Therapists	565	1,930	1,365	<i>Mixed - Bachelor's and Higher; Master's; Doctoral</i>
Life Science-related Technicians	317	1,122	805	<i>Associate's and Higher</i>
Life Scientists	150	468	318	<i>Master's and Higher</i>

Table 8: Approach #2, Indiana Life Sciences-related Occupations: Comparison of Annual Projected Job Openings vs. “Supply” of New Higher-Education Degrees Generated, Adjusted for Graduate Retention Rates

KEY HEALTH & LIFE SCIENCES OCCUPATIONAL GROUPS	Indiana Projected Annual Job Openings, 2012-22	Indiana Degree Graduates Adjusted for Avg. In-State Retention, 2014	“Difference [“+” = More Degr Grads; “-” = Fewer Grads than Openings]”	Degree Levels Generally Required
Healthcare Assistants & Support	3,517	n/a	n/a	<i>High School or Some Postsecondary Credential</i>
Health Technologists & Technicians	2,842	1,179	-1,663	<i>Associate's and Higher</i>
Nursing	2,375	n/a	n/a	<i>Associate's and Higher</i>
IT Occupations	1,330	799	-531	<i>Bachelor's and Higher</i>
Health Diagnosing & Treating Practitioners	1,187	415	-772	<i>Doctoral or Professional Degree</i>
Life Science-related Engineers	769	292	-477	<i>Bachelor's and Higher</i>
Therapists	565	1,038	473	<i>Mixed - Bachelor's and Higher; Master's; Doctoral</i>
Life Science-related Technicians	317	306	-11	<i>Associate's and Higher</i>
Life Scientists	150	128	-22	<i>Master's and Higher</i>

Notes: Degree graduate totals align with levels of degree generally required. For Therapists, represents Bachelor's and Higher. Occupation to Degrees crosswalk developed by the National Crosswalk Service Center. Data not shown for Management occupations due to inability of crosswalk to effectively map degrees to “managers.” Graduation data not shown for Nursing due to dynamic where licensed, already employed nurses are going back to school to earn Bachelor's degrees.

Source: TEconomy analysis of Occupational Employment Statistics (OES) and Occupational Projections data from Indiana Department of Workforce Development; Postsecondary Degree data from National Center for Education Statistics, IPEDS Database; graduate retention data from Indiana Network of Knowledge (INK).

The demand-supply assessment reveals that, when looking at projected annual openings and considering what the experience has been around graduate retention, it is clear that, if steps are not taken to increase retention of graduates for opportunities in Indiana, industry could be facing significant challenges in meeting future needs.

Instances where the “Difference” column shows a negative value indicate an area where fewer annual graduates are expected to remain in state than the number of likely job openings. When considering all

graduates regardless of retention (approach #1), these potential deficits occur for health technologists and technicians and for health diagnosing and treating occupations. Both represent large, high-demand and critical roles within healthcare, at somewhat opposite ends of the educational continuum.

When historic graduate retention rates are applied to the graduate totals (approach #2), these potential deficits occur in Indiana for most of the major occupational groups, and at a substantial deficit for several. These imbalances span the skills continuum in healthcare occupations from health technologists and technicians to health diagnosing and treating, exacerbating the situation seen under the first approach/scenario. The demand analysis identified both of these groups as high-demand occupations, and the qualitative assessment has raised concerns about filling the demand for physicians in particular, as well as lab techs and radiological technicians under the health techs classification.

The adjusted approach also identifies likely deficits in new graduates across all of IT and in engineering occupations relative to the strength in expected job openings. While state schools graduate sizable numbers of engineers in key fields for the industrial life sciences, when the expected retention of engineering graduates is applied, the concerns raised by employers are far more convincingly confirmed by the data. The consistent messages across health and life sciences concerning a lack of IT talent are similarly validated in the demand-supply data assessment.

In nursing, the high-demand profile and serious concerns about meeting demand going forward signal an ongoing imbalance that must be addressed. The increased educational requirements recommended for nurses have created a dynamic by which large numbers of currently licensed nurses are simultaneously working and enrolled in BSN programs. Unfortunately, the project team was unable to access data that would differentiate the graduation of “new” nurses to the Indiana workforce versus those graduates who are already employed. Nonetheless, this data limitation should not downplay the serious indications of pending demand-supply imbalances in nursing.

Individual occupational profiles have been developed regarding the balance or relative alignment between the demand for and supply of an occupation based on the combination of qualitative and quantitative assessments conducted by the project team (see Appendix for detailed profiles). Figure 24 summarizes the key findings across these profiles and assessments and characterizes the alignment using three different-colored circles, with the size of the circle indicating the magnitude of recent hiring for the occupation.

- **Blue circles** represent occupations where the quantitative and qualitative assessments indicate the occupational group is well aligned with respect to supply, meeting current and expected demand with little to no challenges or concerns raised by employers.
- **Gray circles** identify a more “mixed” situation where the project team heard some limited concerns from employers regarding demand-supply dynamics, but not consistently or

universally; and/or the quantitative assessment revealed potential supply shortages, as in the case of health diagnosing and treating.

- **Orange circles** indicate occupational groups where the assessment has identified significant challenges and imbalances in the alignment of supply and demand.

The assessment has identified misalignments across each of the three broad skills groups—low-, middle-, and high-skilled workers, with varying magnitudes of the challenge. Where areas are misaligned, the situation most often reflects strong industry demand that is creating strains on and out-stripping the supply of qualified workers with the right blend of skills and experience.

Figure 24: Summary of Demand-Supply Dynamics across Health and Life Sciences Occupations: Alignment Status + Magnitude

● = Well Aligned
 ● = Mixed, some challenges
 ● = Misaligned, challenges
 (size of bubble = magnitude of recent hiring)

LOWER SKILLED		HIGHER SKILLED	
Healthcare Assistants and Support	●	IT Occupations	●
Manufacturing and Production	●	Life Science-related Engineers	●
		Therapists	●
		Life Scientists	●
		Health Diagnosing & Treating Practitioners	●
		<i>Specialized Skill Sets</i>	
		Health/Bio-Informatics	●
		Clinical Trial Coordinator	●
		Quality Control	●
		Regulatory Affairs	●

The nature of the identified challenges are described below, as well as in each detailed occupational profile that is provided in the Appendix.

Well Aligned. Three occupational groups are viewed as well aligned and were given a blue designation:

- **Healthcare Assistants and Support** represents the only major occupational group that saw an employment decline in Indiana (and across the U.S.) during the 2010–2014 period and thus had relatively weak demand. While this is the largest occupational group in the health and life sciences, the project team heard virtually no concerns about finding qualified workers.
- **Life Sciences-related Technicians** has seen strong hiring, but employers see this area as a strength in Indiana and are able to source qualified candidates and hires; annual graduate figures align well with expected job openings.
- **Therapists** had no imbalances or misalignments identified by employers, and state colleges and universities are graduating a high number relative to annual demand projections.

Mixed, some challenges. The three areas assigned gray circles pose some challenges but are not yet at the same level of concern as those in Orange. This designation suggests a careful monitoring going forward.

It so happens that these challenging areas each represent the more specialized skill sets at a detailed occupational level below the major occupational groups.

- **Quality Assurance/Control**—across the health and life sciences industry, these positions are vital to operations and are consistently identified as “very difficult” to find qualified candidates, particularly in the medical device sector. While the magnitude of demand for these professionals is limited, the skill sets are critical. Customized postsecondary education programs have been developed to address training in specific production environments such as the Quality Management program at Grace College to serve the orthopedics companies in Warsaw.
- **Regulatory Affairs** is raised by industrial life sciences companies as a consistent area of need, though not at critical levels; however, this area is not typically associated with dedicated degree programs, and companies often train incumbent workers in-house and to their specific regulatory requirements.
- **Clinical Trial Coordinators** are also identified by employers in several health and life sciences subsectors as “very difficult” to find qualified candidates. While the magnitude of the profession is not very large, current vacancies and expected hiring during the next 2 years are quite high relative to the existing employment base of companies surveyed. Professionals do not come from a traditional degree field and are often drawn from nursing professions. This dynamic

makes sourcing qualified candidates difficult, requiring recruitment from across the Midwest and the nation.

Misaligned, challenges. Eight of 13 occupational groups are assigned Orange circles based on the assessment, recognizing significant concerns regarding imbalances and the need for potential policy or programming intervention. Nearly all of these occupations have been characterized as “high demand” based on the assessment, and many have corresponding challenges with respect to supply that span occupational aging, significant attrition among graduates out of state, indications of too few graduates, or challenges with sourcing qualified individuals locally or across the state.

- **Manufacturing and Production**—industrial life sciences employers raise numerous concerns regarding the availability of quality “operators” and other skilled production workers. Specific challenges include an aging workforce; finding workers with basic math skills; employability issues, including on-time work arrival, no drug use, professional behavior, and adaptability; and career awareness among students of opportunities in manufacturing. Rapid employment growth plus sizable existing vacancies and expectations among employers for strong hiring in the next 2 years signal a high-demand occupational group. The overall situation signals misalignment and significant challenges for employers ahead.
- **Health Technologists and Technicians**—this is a very large occupational group with strong demand expected to continue according to employers who raise specific concerns regarding finding qualified lab technicians. The quantitative assessment reveals a large potential imbalance in current graduate levels relative to projected annual demand.
- **Nursing**—hospitals and health systems cite numerous concerns regarding the supply of qualified nurses into the near future, including aging workforce with sizable pending retirements in the next few years; high volumes required for effective health services; competition for talent from outpatient centers; capacity limits in clinical residence programs; significant experience requirements in certain healthcare settings (OR, ER, Pediatrics, etc.); increasing educational requirements; shifting healthcare approaches and economic models shifting demands to team-oriented and value-based approaches. All of this, combined with the high-demand dynamic already underway, signals the potential for serious imbalances in the demand-supply equation.
- **IT Occupations**—health and industrial life sciences employers identify major challenges throughout the industry in finding and hiring qualified IT workers. Hospitals have immediate demand for medical coding plus higher-skilled systems demands for administering and managing databases and new electronic health records systems in applications such as EPIC and Cerner. In all industry settings, health and bioinformatics workers are in high demand and difficult to find to manage large data sets spanning clinical trials, patient records, genetics and related sequencing, and agricultural/plant sciences-related data. Workers for precision ag-related big data and analytics are in high demand as well. While IT occupations are growing in

Indiana, they have not outpaced the U.S. and expectations are not for above-average job growth. These IT occupations are therefore not formally designated here as high-demand, but there are clearly major concerns about sourcing qualified workers, and health and life sciences firms are competing fiercely with opportunities for these workers in other sectors. The quantitative demand-supply assessment highlights significant annual deficits in graduates relative to annual job openings, which exacerbates the already difficult situation when competing against other industries for talent.

- **Health and Bioinformatics** (a specialized skill set recognized within IT occupations)—across the health and life sciences industry and its subsectors, the multidisciplinary skill sets associated with health and bioinformatics are seen as a key emerging, immediate need. Employers consistently have these needs top of mind when asked about both near- and longer-term talent needs and cite qualified candidates as “very difficult” to find. Indiana employers are conducting national searches for workers with the educational and skills backgrounds and with pertinent experience. These workers cut across the demand for IT and are needed to manage large data sets spanning clinical trials, patient records, genetics and related sequencing, and agricultural/plant sciences-related data. Workers for precision ag-related big data and analytics are in high demand as well.
- **Life Sciences-related Engineers**—qualified candidates are identified by industrial life sciences employers as “very difficult” to find, with specific strong demand identified by medical device employers for mechanical engineering talent for orthopedic manufacturers. The quantitative assessment reveals a very challenging labor market dynamic with high-demand for engineering workforce combined with expected deficits in new graduates in life sciences-related fields relative to annual job openings in Indiana. The nature of the projected annual needs going forward is heavily tilted toward replacements (82 percent), signaling an aging workforce and pending retirements.
- **Life Scientists**—this represents a highly skilled top-talent field in the health and life sciences, and several Indiana companies have identified this occupation as “very difficult” to find qualified candidates, particularly those with industry experience. Recruiting experienced scientists to Indiana is viewed as difficult, even though employers must recruit across the nation. Employers recognize that candidates often see limited opportunities in the life sciences in Indiana beyond the company for which they are interviewing, and while this is not always truly the case, such perceptions further complicate prospects for hiring success. The recent job growth in Indiana has been very strong and projected demand shows this will continue. The employer survey indicates sizable current vacancies and confirms the strong expectation for new hires during the next 2 years at more than 200. And while the quantitative demand-supply assessment shows expected close alignment, the slight imbalance still raises concern about new graduates entering these professions.

- **Health Diagnosing and Treating Practitioners**—employers cite challenging, but not yet critical dynamics for these high-skilled workers due to the broader shifts happening across healthcare, with particular challenges in rural areas. The group is considered high-demand with a potential imbalance based on the demand-supply assessment raising concerns going forward.

With this demand-supply assessment in hand, and key potential gaps identified for Indiana’s health and life sciences talent, the next section turns to strategic priority areas and solutions that can address these challenges going forward.

Meeting the Opportunities and Challenges for Talent to Drive Health and Life Sciences Development in Indiana: What should Indiana do?

For the health and life sciences industry, the importance of talent is well recognized. Nationally, the industrial life sciences employ more than 50 percent of its workforce in jobs that require at least a bachelor's degree, covering a wide range of occupations involved in R&D, production, quality, and regulatory functions.

In healthcare delivery, increasingly complex cases, technologies, and operating environments drive steady demand for high-skilled professionals and are driving up educational requirements for large segments of the workforce. In Indiana, the 2012 CICP study on Indiana's Competitive Economic Advantage: The Opportunity to Win the Global Competition for College Educated Talent found that life sciences stood out as likely having a higher level of high-skilled workforce than the nation.²³ This above-national level of industry demand for high-skilled jobs sets the life sciences apart from other industry sectors in the state.

The Health and Life Sciences Industry Defined

In this study the industry includes:
The *Industrial Life Sciences* spanning:

- Biopharmaceuticals
- Medical Devices
- Agbiosciences

And *Health Services* which includes hospitals, outpatient centers, medical and diagnostic labs, home healthcare services, and nursing and residential care facilities.

The industry in Indiana represents:

- **1 in 10 Private Sector Jobs** across all skill levels
- **22% growth** in industry employment since 2001
- **High Average Wages** exceeding the overall economy in nearly every key occupational group

²³This higher level of industry deployment of high-skilled talent for the life sciences is based on the higher average wages paid to life sciences jobs in Indiana than the nation. A direct measurement of high-skilled workers employed in the life sciences industry was not possible due to confidential disclosure restrictions by the U.S. Department of Labor if there is a high concentration of life sciences employment in just a few companies, as is the case in Indiana, with large employers such as Eli Lilly and Company.

It is no surprise that a detailed assessment of the demand and supply for health and life sciences talent finds that the growing base of health and life sciences jobs in Indiana is generating significant high-quality job opportunities across a range of skill levels.

- **The health and life sciences industry in Indiana is vibrant and a major economic driver for the state,** recording significant job growth of over 22 percent in health and life sciences occupations since 2001 and continued, though slower, job growth since the economic recovery took hold post-2010. The full industry now accounts for more than 265,000 jobs (as of 2014) or just over 1 in every 10 jobs in the state.
- **These job gains in Indiana are ranging broadly across skill levels and demonstrating the diverse job opportunities afforded by the growth of health and life sciences industries.** Across health and life sciences occupations, Indiana has made gains since 2010 in 10 out of 11 major health and life sciences occupations, with 7 of these occupational groups enjoying double-digit growth from 2010 to 2014. This growth in health and life sciences occupations in Indiana from 2010 to 2014 ranges from lower-skilled production to middle-skilled technicians and allied health workers to high-skilled scientists, engineers, and health diagnosing and treating jobs.
- **Across the mix of skill levels, the jobs being created in health and life sciences occupations are high quality, offering Hoosiers a decent and rising standard of living.** Reflecting the fact that the health and life sciences industry is among our nation's highest-value and most innovation-driven industry sectors, the jobs being created in health and life sciences occupations offer higher and faster-growing wages than the average for the overall economy in Indiana, even for lower- and middle-skilled health and life sciences occupations. The average wages of Indiana's major health and life sciences occupations are all above the average wages paid in private sector industry in Indiana. Even more impressive is that the growth in average wages for all major health and life sciences occupations exceeds the average growth in wages for all private sector industry jobs in Indiana.

What is particularly impressive in Indiana's recent generation of health and life sciences occupations is the strong growth in high-skilled jobs that play a critical role in raising Indiana's capacity to innovate and to stay globally competitive. Not only are high-skilled health and life sciences occupations growing in Indiana, they are outpacing growth nationally. For scientists and engineers employed in the health and life sciences industry, the growth in Indiana has been robust, growing 53 percent and 34 percent respectively from 2010 to 2014, which is more than double the national growth rates for each occupation. Similarly, life sciences managers and healthcare diagnosing and treating occupations grew more than 10 percent over the 2010–2014 period, slightly more than the national average. While it takes a mix of skills to meet the workforce needs of a growing health and life sciences industry, this strong growth in highly skilled health and life sciences jobs in Indiana

²⁴Sam Marwaha, et al., "Biopharma in the coming era of 'connected health,'" McKinsey on Business Technology, Spring 2012.

signals a continued commitment to innovation and product development in Indiana that is critical for a globally competitive industry.

Looking to the future, the demand for health and life sciences jobs seems bright. In the next 2 years, the survey of health and life sciences employers in Indiana completed for this study projects existing vacancies and expected hiring to generate a 15 percent growth in overall health and life sciences jobs. The fastest growth will be in jobs such as clinical trials coordinators, medical/clinical lab technicians, research technicians, engineers, manufacturing and production, and marketing and sales. Looking longer term, the Indiana DWD projects that, through 2022, the level of job openings in health and life sciences will reach over 12,000 annually, not including broader skill needs for IT and manufacturing production workers that health and life sciences industries share with other industries in Indiana. Among the 25 fastest-growing occupations in Indiana, health and life sciences jobs are well represented as these occupations include registered nurses, licensed practical nurses, medical services managers, pharmacists, and family physicians, as well as mechanical engineers, industrial engineers, and computer systems analysts.

So, there is much to celebrate around Indiana's recent gains in health and life sciences occupations. Still, Indiana cannot afford to be complacent. While demand is strong and continues to grow, significant challenges lie ahead for Indiana's capacity to meet the needs of industry for health and life sciences workers.

- **An aging workforce is a looming issue for health and life sciences talent.** All types of health and life sciences occupations appear to face the aging of the workforce. The challenge is not just about finding replacement workers, but also about finding the best ways to sustain the knowledge and expertise gained over the years that will be lost with increased retirements. Pending retirements pose broad concern across production, nursing, and even scientific jobs found within the health and life sciences industry.
- **Changing demands in healthcare delivery.** There is a major shift in the business model of healthcare underway that is already placing new skill demands on the healthcare workforce. Healthcare is shifting to a more value-driven model requiring a focus on delivering measurably better, quality outcomes for patients for reimbursement. This new business model for healthcare is creating an increased focus on team-based healthcare delivery models that is refining the occupational mix needed to deliver healthcare to patients and creating needs for new skills within healthcare occupations, such as more team-based working, project management, and communications skills. Newer health occupations are also in demand to offer more flexible delivery of healthcare services to meet the new business model focused on healthcare outcomes, such as physician assistants and nurse practitioners.
- **Rise of IT across health and life sciences.** The unprecedented massive datasets being generated from modern biological research on humans and plants, patient medical records, increased

utilization of advanced imaging and molecular diagnostics, and the rise of remote monitoring in healthcare delivery and agriculture are all transforming health and life sciences into an information-dominated business. For instance, McKinsey heralds a coming era of “connected health” that will feature more data-based transparency of health innovation and healthcare delivery to focus on the right treatment for the right patient at the right time.²⁴ The ability of health and life sciences to make use of IT and the analysis of the large datasets being generated is becoming a competitive issue, requiring increased availability and quality of IT and data science skills in the health and life sciences workforce.

- **Stiff competition from other leading health and life sciences states is raising the bar for competing for talent.** Compared with other leading states in health and life sciences, Indiana is in the middle of the pack in its growth, concentration, and average wage levels across all health and life sciences occupations, though recent wage gains have been stronger in Indiana than among other leading states. Many of the higher-skilled health and life sciences occupations—such as scientists and engineers—represent national labor markets, where Indiana must compete both for nationwide talent as well as for homegrown top talent from Indiana’s universities.
- **Imbalances in the alignment of supply and demand pose significant challenges across eight of the major health and life sciences occupational groups.** These eight major occupational groups reflect the strength of Indiana in generating “high demand” but are significantly impacted by a combination of issues, such as the aging of the workforce, significant attrition among college graduates leaving the state, indications of too few graduates, or challenges with sourcing qualified individuals locally or across the state.

Perhaps the most broad-based talent need across the health and life sciences in Indiana is in IT skills. Both industrial life sciences and healthcare services businesses surveyed raised the importance of meeting the fast-rising demand for IT skills both as its own growing occupational group within health and life sciences and as an increasingly demanded skill within all existing occupations. The focus on IT also is found across a range of skill levels, from a need for lower- and middle-skilled workers to help operate data systems and input medical records to requirements for more high-skilled workers capable of software development and undertaking the analysis, often requiring specialized bioinformatic skills, of large datasets.

Meeting this need for IT skills is a competitive concern based on our benchmarking to other leading health and life sciences states. IT is the one area of workforce where Indiana is especially lagging, with Indiana’s growth and concentration of workforce in IT jobs well behind that of other leading health and life sciences states.

To move forward, Indiana needs a comprehensive approach to address the full implications of the demand and supply assessment in ensuring a robust talent base to meet the needs of the state’s health and life sciences industry. This comprehensive approach requires not only addressing the

longer-term efforts to generate homegrown talent in the state to meet the needs of industry, but also the near-term needs of industry to both upgrade the skills of the existing health and life sciences workforce and compete in the national and international markets for top-level scientific, engineering, and experienced management talent.

While individual education and workforce initiatives are important pieces of the puzzle, there is not a silver bullet that can address the broad-based needs for talent confronting health and life sciences occupations. What is important is an approach that engages all stakeholders in public-private partnerships that build capacity and can be scaled up for success.

Four broad strategic priorities need to be pursued through public-private partnership initiatives, including the following:

- **Ensuring a strong foundation of STEM skills to prepare for postsecondary education and lifelong learning required for careers in health and life sciences occupations.**
- **Fostering postsecondary talent generation in Indiana that promotes strong connections to career opportunities in health and life sciences.**
- **Upgrading the skills of Indiana’s incumbent health and life sciences workforce** to meet the changing skill demands of the fast-paced innovations and changing business models transforming the health and life sciences industry.
- **Raising Indiana’s ability to attract and to retain top health and life sciences talent** across the highly competitive national labor markets for scientific, engineering, and medical talent.

The following sections on recommendations examine each of these strategic priorities, considering the following:

- Indiana’s strategic needs that serve as a call to action, based on the data analysis, employer survey results, and guidance from this study’s Advisory Committee;
- Indiana’s ongoing efforts that can serve as building blocks for future actions; and
- Suggested actions for Indiana based on gaps in existing programs and best practices from other states that address Indiana’s unmet strategic needs.

Ensuring a Strong Foundation of K-12 STEM Skills

A Call to Action: Indiana's Strategic Needs

New talent generation is very much about the future of Indiana and the commitment of the state to the economic prosperity for future generations. In today's highly competitive global economy, it is essential that the next generation of workers in Indiana be equipped with STEM skills as well as the capability for lifelong learning.

The starting point for new talent generation is having a strong foundation at the K-12 educational level. Still, K-12 is generally not an end in itself since most of the jobs in health and life sciences require additional postsecondary education. To be successful in new talent generation, states need a fully integrated approach across K-12 STEM and postsecondary education that features career awareness of health and life sciences occupations, educational requirements at the K-12 level, and proactive articulation toward postsecondary degrees and credentials in health and life sciences fields.

Given the major needs around both K-12 STEM and post-secondary education in advancing new talent generation, the industry-led Advisory Committee called for each to have its own strategic priority that focuses on the integration across these two highly inter-related educational areas.

The challenges to K-12 STEM education in Indiana are clear and critical. In surveys and interviews, Indiana health and life sciences industry executives cite K-12 STEM education as “absolutely critical to our success and our future.” Throughout this study, the consistent emphasis and messages from industry represent a primary importance placed on the demand for STEM education, experience, and technical skill sets when discussing top scientific talent; needs for bioinformatics, math and statistics professionals; engineers; IT; physicians and surgeons; and other related areas across health and life sciences.

Areas of concern raised by industry and postsecondary education leaders that relate to K-12 STEM readiness and career awareness include the following:

- Need for statewide STEM efforts to begin much earlier, with a foundation in elementary grades, to address the subsequent fall-off in student interest and performance in math in high school.
- A general lack of student awareness of career opportunities in the health and life sciences industry by K-12 students; this has translated into recruitment challenges for Indiana's postsecondary institutions, particularly the community colleges in life sciences disciplines and applied programs.

- Importance of emphasizing teacher professional development as well as student learning.

The data on Indiana's K-12 STEM education performance reflect the urgency suggested by health and life sciences industry executives. Indiana shows middling performance with little to no improvement in national assessments in science and math against peers from other states. Indiana's 8th graders score right near the national average in both subjects, ranking 18th in mathematics in 2013 and 27th in science in 2011, the latest data available from the National Assessment of Educational Progress (NAEP). From its position in 2005, Indiana moved ahead in state rankings one spot in math and dropped three positions in science. Industry representatives raise related concerns about a deficit of teachers qualified to teach STEM education.

The surveys and interviews with health and life sciences industry executives did point to one area where a more direct connection between K-12 and health and life sciences jobs is possible, namely for production workforce. There are opportunities for some production jobs for high school students proficient in math and technology skills that also have soft skills needed at the workplace (no drug use, on-time work arrival, ability to work in teams, good communication skills, etc.). These students can directly qualify for production work after high school with only some on-the-job training needed. Often these entry-level production jobs can then offer students pathways to raise their skill levels through further education and training as they earn their salaries and build up work experience. For instance, Roche is actively seeking to upskill its production workforce and offers a generous tuition reimbursement program to incentivize workers to obtain a bachelor's or advanced degree while working.

The Building Blocks for Future Actions: Indiana's Ongoing Efforts

Health and life sciences industry executives do recognize and appreciate the growing statewide and community efforts in and around K-12 STEM education, but emphasize that more can and should be done.

The private and philanthropic sector in Indiana has prioritized advancing STEM-related education and skills across its K-12 (and in some cases K-16) system for both students and teachers. These initiatives are aimed at providing a strong foundation to prepare students for college, career-readiness, and lifelong learning. In addition, STEM subjects and skills, while always important, are increasingly in demand for science- and technology-based industries driving global innovation, certainly including the health and life sciences. Particularly through the aligned focus of its corporate and philanthropic leaders, Indiana has been active in promoting and advancing STEM education and workforce initiatives across the K-12 system and in addressing employer concerns on a number of fronts. The Indiana STEM education programs and initiatives identified and presented here are not meant to represent a comprehensive assessment or census of programs, but rather to reflect what was emphasized to the project team as key initiatives and reflective of the types of efforts being advanced across the state.

I-STEM Resource Network. The Indiana Science, Technology, Engineering and Mathematics (I-STEM) Resource Network, begun in 2004 through the efforts of BioCrossroads and subsequently administered through Purdue University, is connecting higher education officials, corporate leaders, and policy makers in a shared focus on the improvement of K-12 STEM studies. The concern was the large numbers of new bioscience jobs expected to be created in Indiana and the need to position Indiana's workforce to take advantage of these job opportunities by creating programs to improve STEM knowledge in K-12 students.

- The I-STEM Resource Network is a statewide consortium of 14 higher education institutions dedicated to measurably improving K-12 student achievement in the STEM disciplines by focusing on professional development for K-12 STEM teachers, the creation of formal relationships between these teachers and institutions of higher education, and hands-on activities and learning opportunities for students and families. As a specific area of focus, I STEM, through the Indiana Science Initiative, is working to systematically improve science education in grades K-8.

Project Lead the Way. PLTW is a national non-profit organization promoting and providing programs in K-12 STEM education across the U.S., from its headquarters in Indianapolis. The organization develops STEM curricula and programs for teacher professional development with a footprint that reaches more than 8,000 K-12 schools in every state. PLTW uses a project-based approach driven by student-led inquiry to engage students in a multidisciplinary STEM orientation and guided by principles including collaboration and research/evidence-based and problem-based approaches.

- In 2015, PLTW announced that, with support from the Lilly Endowment, 10 Indiana high schools will have access to a new PLTW Biomedical Science program, a 4-course sequence and career exploration with topics spanning human medicine, physiology, genetics, microbiology, and public health.
- Impacts: In one study of Indiana high school graduates conducted by researchers from the IU School of Education, PLTW participants were found to be nearly 3 times as likely to major in a STEM field in college, and 3 to 4 times more likely to study engineering; and they were more likely to persist into the second year of college in pursuing these degrees.²⁵

Advanced Placement Training and Incentive Program—Indiana (AP TIP-IN). The AP TIP-IN program, administered by the University of Notre Dame's Institute for Educational Initiatives with support from the National Math and Science Initiative (NMSI), the U.S. Department of Education, the University of Notre Dame, and the Indiana State Department of Education, is focused on increasing the enrollment and performance of high school students in Advanced Placement courses in math, science, and English. While the program focus is on AP courses, the broadly stated mission of the initiative is to

²⁵Gary Pike and Kirsten Robbins, *Using Propensity Scores to Evaluate Education Programs*, Center for Urban and Multicultural Affairs, Indiana University School of Education at Indiana University-Purdue University Indianapolis, 2014

improve the college and career readiness of Indiana students. The program also seeks to support teachers with professional development and continuous support via content directors.

- AP TIP-IN has been active in 30 Indiana public high schools.
- Results and impacts cited from the AP TIP-IN website find the following: In the latest school year, more than 2,500 students in AP TIP-IN schools achieved a score of 3, 4, or 5 on nearly 3,500 College Board AP math, science, and English tests, thereby becoming eligible for college credits for those courses. Over 3 years of the program, more than 12,000 students took nearly 18,750 AP tests in these subjects; about 4,900 of those students earned 7,600 credit-eligible scores.

Indiana Afterschool Network (IAN). IAN provides learning opportunities for Indiana’s K-12 students beyond the classroom in afterschool and summer programs that prepare students for “college, careers, and life.” The program dates back to 2001 with a grassroots effort of school districts and supported by the Indiana Department of Education. Today, IAN cites thousands of state and national partners spanning education, youth development, business, government, and community organizations. Program activities vary but span tutoring and homework, STEM-focused programs, mentoring, projects such as building robots, creating art projects, working in teams, contributing to the community, and preparing for college and careers.

STEM Teacher Recruitment Fund. Managed by the Indiana Commission for Higher Education (CHE), the STEM Teacher Recruitment Fund was established in 2013 to provide grant funding for recruitment, retention, and training of high-quality STEM teachers into schools experiencing talent shortages and/or in underserved areas. In early 2016, a second round of funding was approved for 2016–2017 totaling \$9.6 million; and the CHE has awarded funding to 10 recipients that include colleges, universities, and non-profit workforce and education stakeholders, including the Woodrow Wilson Teaching Fellowships, the New Teacher Project, Teach for America, the Independent Colleges of Indiana, the Purdue Research Foundation, and others. These organizations will work to spur innovative programs to bring new STEM teachers into Indiana.

Million Women Mentors. This program is advancing the engagement of one million STEM mentors with the aim of increasing the interest and confidence of girls and women in pursuing STEM-related education programs and careers. The program is an initiative of STEMconnector, recognizing the underrepresentation of girls and women in STEM-related programs and occupations, and is bringing together more than 60 partners, reaching more than 30 million girls and women, 45 corporate sponsors, and 35 state leadership teams. In Indiana, former Lt. Governor Sue Ellspermann has encouraged participation among Indiana’s corporations and pledged 5,000 mentors toward the national goal.

In addition to broader initiatives, specific STEM-related community initiatives and schools have been developed or planned, including the following:

- **Warsaw, Indiana STEM initiatives**, including launching a STEM Academy at Washington Elementary School; the Moving STEM Forward Program with OrthoWorx that includes a roadmap for STEM education at all grades, teacher professional development, creation of a dedicated OrthoWorx STEM advisor, and creation of a STEM Mobile Learning Lab.
- **Purdue Polytechnic High School** (in development) in Indianapolis, a charter school with plans to open in 2017 and feature a rigorous curriculum featuring relationships with industry and a partnership with Purdue University.

Addressing Indiana's Unmet Strategic Needs: Drawing on National Best Practices and Industry Insights

The efforts around K-12 STEM education is more akin to a marathon than a sprint, and creating the foundation of high performing K-12 schools and students is a long-term effort. The concerns of health and life sciences industry executives to do more and better is not focused on short-term fixes, but making continual progress and scaling up efforts that work.

Indiana is already doing much that is in line with national best practices around K-12 STEM education, but it is not clear that these efforts reach across the state uniformly. There are additional components necessary to complement these efforts already underway in Indiana and to ensure a more comprehensive set of coordinated initiatives that can achieve a larger scale. The project team examined the STEM-related initiatives in place and identified gaps with respect to what was (and was not) being addressed by these programs and what more could be done to specifically address the linkages with, and demands of, the health and life sciences industry.

A renewed and comprehensive call to action and dedication of resources for STEM education by the state of Indiana. Much of Indiana's progress in STEM education has been driven by sustained commitments from the strategy of corporate and philanthropic leadership. Meanwhile, support for STEM as a principal state-sponsored education priority has been sporadic and often below the radar. Indiana's Governor and Superintendent of Public Instruction, together with the Indiana General Assembly, need to be clear in their support for and investment in K-12 STEM education as a principal driver for the state's future.

Increasing the outreach to diverse student populations to engage them more fully in STEM education. Building a more inclusive talent base across students is critical for Indiana's economic future. An increasing number of K-12 students are coming from minority and often foreign immigrant families, populations that are underrepresented in STEM fields of study as well as the STEM workforce.

In Illinois, the efforts of iBIO's EDUCATE Center suggest that targeted outreach can make a difference, in this case to girls in grades 3–8 through an after-school program, known as Stellar Girls. This program was developed with support from Astellas USA Foundation. Its activities are woven into 20 lessons that provide authentic problem contexts and student-centered investigations. EDUCATE

staff provide program training during summer professional development sessions. After-school Stellar Girls lessons are led by school instructors or community members, with scientists and engineers from industry and higher education assisting with instruction of select lessons to provide additional insight and career connections to the topics. Measurable program outcomes include significant gains in teacher best practices in science education and significant gains of an average of 19 percentage points on science content tests by 5th and 6th grade Stellar Girls and 13 percentage point gains for 7th and 8th grade girls. In the 2015–2016 school year, 26 schools and an estimated 400 girls are participating in the program.

Seeing a substantial need to improve STEM education and career awareness both broadly and more specifically in the communities in which they operate, individual companies are engaging in STEM initiatives targeting diverse populations typically underrepresented in STEM programs and careers, with the following as examples:

- In the San Francisco Bay Area, Biotech Partners provides a comprehensive, hands-on, bioscience education and job training program for populations underrepresented in the sciences—especially minority students (97 percent), young women (54 percent), and those from low-income households.
- In New Jersey, Students 2 Science, Inc. (S2S) is a non-profit corporation that inspires, motivates, and educates middle school and high school students to pursue careers in STEM subjects in the lower-income school district of East Hanover, New Jersey. S2S operates a 10,000-square-foot Technology Center in East Hanover, New Jersey, where students perform hands-on, age-appropriate experiments that emphasize the subjects taught in their science classrooms.
- In Michigan, a partnership of the University of Michigan and Johnson & Johnson supports a postdoctoral research program for underrepresented minority doctoral candidates. The program focuses on research aligned with the Immunology Therapeutic Area at Janssen R&D, part of Johnson & Johnson’s pharmaceutical R&D, in strategic scientific focus areas. Each postdoctoral fellow is jointly mentored by a university faculty member and a company scientist and spends time working at both sites. Research projects are jointly developed to encourage collaboration and alignment of research interests.

Better linking STEM education to awareness of health and life sciences careers. Many of the health and life sciences industry executives are concerned about making a more explicit connection between STEM education and broad and varied career opportunities in the health and life sciences. This can be done in a variety of ways. One is to establish more integrated high school–college career academies. The American Hospital Association notes the Rhode Island Nurses Institute Middle College Charter School, which is focused on careers in the health sciences and helps students complete college-level courses while still in high school.

Another approach is to complement high school STEM education with more hands-on, application-oriented career courses. This is the approach taken by the Connecticut Career Choices (CCC) program over a roughly 10-year period, and was noted by the Biotechnology Institute as a best practice in its report, *Taking the Pulse of Bioscience Education in America: A State-by-State Analysis*.²⁶ The CCC program built off the basic courses in STEM (such as biology, math, and other sciences) and demonstrated their relevancy to students, linking to mastering critical thinking, problem-solving, and experiential learning. CCC involved innovative curriculum, online learning tools, professional development for teachers, experiential learning, and complementary extracurricular programs. The signature event for CCC was the Governor’s High School Innovation Challenge, in which student teams are “challenged” to incorporate advanced technologies to develop a “mock” company and author a White Paper that describes innovative applications of technologies and services. At its most active phase, three bioscience courses are available: Biotech R&D, Foundations of Health Science and Technology, and a Science Research Seminar that involved 17 high schools and more than 600 students. A National Science Foundation (NSF) grant was awarded to articulate CCC high school courses to Connecticut’s College of Technology and enable awarding college credit for CCC high school courses.

Life sciences companies are promoting experiential learning opportunities with access to industry-relevant technologies and career insights. The Amgen Foundation has supported hands-on educational outreach to middle school, high school, and college students and teachers involving five states, Puerto Rico, and the United Kingdom. Students and teachers engage in industry-relevant molecular biology curricula, tools, and techniques used in therapeutic discovery that include recombinant DNA techniques, the polymerase chain reaction (PCR), and key molecular tracers such as red fluorescent protein. At the same time, students develop science literacy, experience the challenges and thrills of working in a lab setting, and gain valuable insights into potential college and career paths in life sciences fields. Teachers gain professional development in current, advanced science and a framework and lab equipment for bringing these applications into the classroom. The areas emphasized reflect aspects of the R&D process for which fundamental STEM knowledge and skills are needed. More than 50,000 students and hundreds of teachers participate annually. Independent evaluators have found significant gains among participating students in all areas relating to science, including attitude, interest, confidence, knowledge, and interest in pursuing a career.

Leveraging place-based customized training. Indiana’s many cities are now sites to research parks and other place-based developments to advance both medical districts and industry-led innovation districts. These are important economic-development tools that can be leveraged for broader STEM education outreach. An excellent example is what has been taking place in Baltimore around the University of Maryland’s BioPark development. BioPark has been active in creating linkages with the largely low-income, minority community of West Baltimore in which it is located. A dedicated fund supported by a small portion of tenant rent payments has provided grants for community projects,

²⁶*Taking the Pulse of Bioscience Education in America: A State-by-State Analysis, prepared by Battelle in Cooperation with Biotechnology Industry Organization (BIO) and the Biotechnology Institute, May 2009.*

including the purchase of lab and computer equipment for the nearby Vivien T. Thomas Medical Arts Academy, a Baltimore City health sciences magnet high school. BioPark is also creating career pathways to jobs being created in the research park in manageable steps for students coming out of schools like the nearby city public high school, the Vivien T. Thomas Medical Arts Academy, who may not have seen college in their future. After obtaining their 4-year high school degree, students can pursue a 2-year associate's degree at the Life Sciences Institute of the Baltimore City Community College that opened in the BioPark in 2009. From there, they could go on for 2 more years at the university to obtain a bachelor's degree in medical technology. Most recently, BioPark is home to a newly formed molecular biological manufacturing, distribution, and pharmacokinetics company, Baltimore BioWorks, Inc., whose mission is to become the first minority-owned, self-sustaining, vocational biotechnology training company. It is teaming up with the BioTechnical Institute to offer industry-led workforce development for laboratory technicians among recent high school graduates through a grant from Maryland's EARN Initiative – standing for Employment Advancement Right Now.

Fostering Postsecondary Health and Life Sciences Talent Generation in Indiana

A Call to Action: Indiana's Strategic Needs

Efforts underway at the postsecondary level to educate the future workforce in skill sets from science to engineering to IT to health fields have the opportunity to more immediately meet the needs of employers for new talent generation.

Overall, Indiana's colleges and universities are viewed as a valuable resource and held in high regard by health and life sciences industry executives. The data on graduates confirm that Indiana's colleges and universities are generating a significant number of graduates across a broad mix of degree fields aligned with the major health and life sciences degrees. Still, there are concerns about whether the level of talent being generated and retained in Indiana is sufficient.

For healthcare occupations, the demand for new workers is outstripping the sizable number of graduates being generated in Indiana in many occupations. A comparison of the total number of degrees generated each year to projected annual job openings suggests shortfalls in healthcare occupations, such as health technicians and health diagnosing and treating practitioners. Plus, nursing is facing high demands and employer concerns of shortfalls, though hard to judge from a comparison of recent graduates to job openings since many incumbent nurses with AA degrees are having to return for their bachelor's degree due to rising skill requirements.

For other health and life sciences occupations, involving research, engineering, and IT, Indiana seems to be generating more graduates than job openings; but, a closer examination suggests this pool of graduates is largely leaving Indiana for jobs. When the total number of degrees generated each year is adjusted for Indiana's retention of graduates for employment in the state, then Indiana falls well short in those engineering and IT graduates utilized by health and life sciences companies and slightly below the job openings for research scientists and technicians.

If Indiana could increase the numbers of in-state students pursuing degrees in engineering and IT degrees relating to health and life sciences occupations, then it would go a long way toward addressing this imbalance. Across academic fields related to health and life sciences occupations, 54 percent of in-state residents graduating from Indiana public colleges and universities work in Indiana, but only 7 percent of out-of-state residents. The imbalance between in-state and out-of-state students is particularly high in engineering, where two-thirds of the graduates from public universities

in Indiana are from out of state and only one-third from in state. In IT, nearly 4 of 10 graduates are from out of state. Among all other (non-engineering and non-IT) degree fields related to health and life sciences, roughly 80 percent of the graduates are from in state.

Beyond these broad trends in the alignment of graduates and projected annual job openings, there are other insights into the demand and supply for postsecondary talent raised from surveys and follow-on interviews of industrial life sciences and health care companies.

- The one significant shared need between industrial life sciences and healthcare is for IT workforce. While the overall numbers of IT workers in demand are not as high as the needs for more traditional health and life sciences workers, such as nursing or scientists or technicians, both industrial life sciences and healthcare services businesses surveyed raised the importance of meeting the fast-rising demand for IT skills. Similar to scientists and engineers, the health and life sciences needs to compete with broader industry demand for IT workers, which makes fulfilling the industry needs harder. Plus, there are specialized IT skills needed in the health and life sciences, such as understanding the privacy, content, and uses of medical records as well as the fast-moving bioinformatics field requiring an interdisciplinary academic and experiential background that spans biology, statistics, computer science, and use of specialized database programs to analyze genomic data.
- In healthcare delivery, the critical challenge is meeting the high demand for nursing across the diverse range of practice areas and healthcare settings in which nurses work. Not only is the demand for nursing extremely high, with nursing being the number 1 occupation identified in Indiana for job openings by the Indiana DWD, but the skill sets required are rising. The growing complexity of medical technologies and settings has led the IOM to recommend that the share of nurses with a bachelor's degree should increase from 50 percent to 80 percent by 2020—a recommendation that is now being adopted in hospital accreditation requirements and is resulting in many incumbent nurses returning to school for a bachelor's degree. Plus, there are expanding roles for nursing as part of new team-based healthcare delivery focused on raising health outcomes as well as providing a new frontline in the delivery of primary care. Increasingly, new types of roles for nurses are arising, such as nurse practitioners who are actively involved in diagnosing medical conditions and prescribing treatments under the supervision of physicians.
- In industrial life sciences, the demand at the postsecondary level is largely found in science and engineering that, unlike degree programs in healthcare fields, require Indiana life sciences companies to compete with broader industries for the talent being generated. This presents a challenge for the industrial life sciences companies to expose these science and engineering students to the opportunities and specialized requirements of careers in the life sciences. This broader exposure requires not just engaging students in internships, but having science and engineering curriculum reflect the more specialized regulatory and quality requirements found in the life sciences.

Another challenge for aligning students in science and engineering fields with the life sciences is the growing demand for more multidisciplinary educational backgrounds and competencies, not only in one scientific or technical area, but also in a functional business capacity. Indiana life sciences industry executives referred to this need as one for “professional hybrids” who are able to link scientific knowledge with business acumen to advance new product development through its life cycle. Given the growing complexity of the life sciences and the increased use of strategic alliances and other models of open innovation, the science and engineering workforce in life sciences is facing the need to manage more complex business situations. This is a national need, but Indiana universities and colleges should address this broader skill set as an increasingly important component in the education of science and engineering students.

The Building Blocks for Future Actions: Indiana’s Ongoing Efforts

There are growing efforts taking place to create better alignment of postsecondary degree and credential programs with the needs of the health and life sciences industry. Examples of these efforts include the following:

- **Grace College Medical Device Quality Management.** Also in partnership with OrthoWorx, Grace College has a new five-course sequence focused on quality management that can be applied at the certificate, bachelor’s, or master’s levels. The courses utilize industry professionals with extensive experience and focus on critical components of quality management, including quality systems, postmarket surveillance, design control and assurance, manufacturing quality and supply chain management, and statistical processes.
- **Ivy Tech Community College Orthopedic Quality Standards and Technical Skills Certification.** Another example of a targeted orthopedics quality approach, Ivy Tech offers a program focused on developing technical and soft skills relating to quality standards specific to orthopedics manufacturing and principles of lean manufacturing. A three-course sequence includes introduction to FDA requirements, lean manufacturing, and CNC machine lathe and mill setup and training. Following course completion, an individual can then take three National Institute of Metalworking Skills exams to earn key credentials.
- **Ivy Tech Community College-Bloomington Biotechnology Program.** Ivy Tech-Bloomington, with funding support from the Lilly Endowment, NSF, and the State of Indiana Strategic Skills Initiative, offers certificate programs (with focus in Biopharma Manufacturing, Regulatory Affairs) and 2-year associate’s degree programs in biotechnology that transfer to 4-year institutions, including to IU-Bloomington. The Biotechnology program partners with a number of local pharmaceutical, agbioscience, and medical device companies and research labs to offer hands-on lab work that translates directly to company needs for biological lab technicians.
- **Community Health Nursing Academy at Ball State University** is a nursing program designed for students to earn a “degree in three” that includes core university and nursing requirements

to earn a baccalaureate in nursing in 3 years. Community Health Network partners with Ball State to host students for clinical courses and employ them part-time as nursing assistants or as student externs across the health network.

- **Marian University for St. Vincent Health Accelerated Nursing Program** in Indianapolis is designed for individuals who already have a bachelor's degree to more easily shift careers and become a nurse. The program is “accelerated” utilizing online courses and clinical experience in St. Vincent's medical and simulation facilities for a 16-month track to earn a BSN degree.
- **Indiana University Bioinformatics Programs.** IU, through its School of Informatics and Computing, offers degree programs in informatics at the bachelor's, master's, and doctoral levels with a degree in bioinformatics at the master's level and specializations in health informatics and bioinformatics available for PhD students. The programs are multidisciplinary with students integrating technological skills and computer science methods with diverse disciplines and applications. The 2-year MS in Bioinformatics program, also referred to as computational biology, integrates informatics with coursework and knowledge in biology, mathematics, statistics, and related fields and includes a year-long capstone research project. The Doctoral program in health informatics leverages partnerships and collaborations with the School of Medicine, the School of Nursing, the School of Health and Rehabilitation Sciences, and the Regenstrief Institute on the Indiana University-Purdue University Indianapolis (IUPUI) campus, which is a premier research center in medical informatics.
- **Engineering schools in Indiana, such as Purdue and Rose-Hulman, are making efforts to grow biomedical engineering programs at both the undergraduate and graduate levels.** While not as well established as other engineering programs in Indiana²⁷, this suggests an increased interest in areas such as biomechanics, biomaterials, and bioinstrumentation within engineering degree programs. Still, not much is yet being offered through courses for more traditional engineering majors, such as mechanical engineering, to learn about medical devices. For instance, among the minors in mechanical engineering at Rose-Hulman, while there are areas of concentration for transportation, aerospace, energy, and production, there is not yet an area of concentration for medical devices.

Overall, while some of these programs are promising, relative to the size of the needs for technicians and science and engineering workers, these efforts are still small. Many of these specialized degree and certificate programs are also having difficulty recruiting students, which suggests the challenges of aligning K-12 STEM to more postsecondary career-oriented programs.

To address the issue of curriculum and better exposing science and engineering majors to the industrial life sciences, Orthoworx has undertaken an innovative value-chain mapping approach to

²⁷For instance, at Purdue University, the engineering school is rated 9th in the nation at both the undergraduate and graduate levels, but only 22nd in biomedical engineering at the graduate level and unranked nationally at the undergraduate level.

show the variety of skills required across the life cycle of a medical device from product development, advanced manufacturing, distribution, and reimbursement. Orthoworx is now using the value-chain mapping to reach out to Indiana’s academic institutions on the disciplines and skills required to meet the needs of the state’s orthopedic industry and to inform future collaborations, including experiential learning opportunities for faculty and students.

One highly regarded program to closely align industry needs and postsecondary education comes from outside the industrial life sciences, the **Toyota Advanced Manufacturing Technician (AMT) Program at Vincennes University**. This effort is widely considered by industrial life sciences industry executives as a “best practice” model for combining classroom learning with applied, apprenticeship type work. The Toyota AMT Program is a unique education-to-work 2-year degree program that combines paid work experience with “cutting-edge curriculum” from a global leader in advanced manufacturing. Students accepted receive a “virtual scholarship” with paid work that can cover room and board and a structure of 3 days of school and 2 days of work at the Toyota manufacturing facility in Gibson County. In addition to coursework in manufacturing, the AMT program includes courses/modules in safety culture, workplace organization, lean manufacturing, problem solving, and maintenance reliability, combined with emphasis and reinforcement on soft skills and workplace behaviors such as attendance, initiative, communication skills, and professionalism. The program offers graduates a coordinated career pathway in an advanced manufacturing setting.

Addressing Indiana’s Unmet Strategic Needs: Drawing on National Best Practices and Industry Insights

There is an opportunity for Indiana to make major strides in better aligning its postsecondary education with the opportunities and needs in health and life sciences for new talent generation. This is especially true given the overall strength of Indiana’s colleges and universities as traditional generators of new graduates.

In terms of addressing unmet strategic needs for postsecondary new talent generation, there is an opportunity to radically scale up the promising efforts underway to create a more seamless school-to-career transition as well as provide opportunities for recent college graduates to gain career building skills.

Scaling up school-to-career transitions. Often a school-to-career transition is associated with going from high school to work. For the health and life sciences, this concept needs to be raised a level to going from postsecondary to work. One example of such a program at scale is South Carolina’s Apprenticeship initiative. This effort features a wide range of apprenticeship opportunities that are customized to employer needs involving on-the-job training and technical instruction tied to industry standards (often provided through technical colleges) and “scalable” wages plus \$1,000 annual tax credit for each registered apprentice employed for up to 4 years. The program also includes a “youth apprenticeship” approach for high school students with production and other middle-skilled jobs that

will not require a postsecondary degree. Since 2007, South Carolina’s apprenticeship programs grew from 90 in 2007 to 768 today, and participation now reaches over 6,000 annually.

Advancing opportunities for targeted courses, certificates, and career-focused degrees for life sciences. A concern for many life sciences employers is that many students pursuing science, engineering, or IT degrees do not have an orientation or understanding of the requirements or opportunities in the life sciences. To address this concern, there needs to be a concerted effort to build out curricula, certificate programs, and specialized degree programs. One example is Bio-Link, an NSF-funded Advanced Technology Center of Excellence, supporting a network of college efforts designed to provide a 1-year program in biotech laboratory technologies to recent graduates in biology and chemistry—with 16 community colleges offering shared coursework and key program components (internships, regional workshops, etc.) across the nation, including California, Massachusetts, and St. Louis.

Improving alignment of engineering student design projects, cooperatives, internships, and other experiential learning and professional opportunities with the life sciences. Building on the efforts to grow biomedical engineering programs within Indiana’s postsecondary engineering schools, it is critical to simultaneously connect classroom learning with experiential and applied opportunities with industry. A unique characteristic of engineering programs is the senior design project undertaken as a capstone, often team-driven project with an applied industry focus (including real deadlines and budgets, and often direct interaction with a company) to design and prototype a product, electronic device, or software system. Likewise, internships and co-ops offer meaningful experiential learning opportunities and exposure to real-world technologies in a corporate environment. Each of these represent opportunities for engineering students to engage with, and learn more about, careers in the industrial life sciences and healthcare delivery sectors.

Top biomedical engineering programs, such as those at the University of Pennsylvania and Stanford University, are connecting graduate students with clinicians to see first-hand how to translate research and ideas from the bench to the bedside, and their professors are often active partners with the life sciences industry. Such opportunities must also be afforded to students in mechanical and other engineering fields to see viable career paths in the life sciences.

Internships are also an effective means of connecting engineering students with career opportunities in industrial life sciences. For instance, OrthoWorx and its constituent Warsaw-based orthopedics companies are employing approximately 400 interns, involving both in-state and out-of-state students. Feedback indicates the interns are very excited about the career opportunities. Still, feedback from other industrial life sciences employers indicates internship programs face limits on growing to scale and offering deep experiences.

For healthcare professionals, beyond new educational program activities at the postsecondary level, there is a need for public policies to make sure nursing specialists and physician assistants

are working at the “top of their license.” This means removing excessive rules and regulations that limit the ability for these highly trained healthcare professions to practice. At a time when health systems are placing a higher priority on more integrated, team-based primary care in community and alternative settings to ensure better health outcomes, these high-skilled nursing specialists and physician assistants are needed to practice to their full capabilities.

Upgrading the Skills of Indiana's Incumbent Health and Life Sciences Workforce

A Call to Action: Indiana's Strategic Needs

Existing workforce skills are critical since, over any 5-year period, it is likely that well over 80 percent to 90 percent of the workers in health and life sciences industries will reflect those working today in the industry. The fast pace of technological changes taking place in health and life sciences is requiring continual skill upgrading for Indiana's existing workforce to stay competitive. The survey of health and life sciences companies identified many areas of both technical skill upgrading as well as broader employability skill upgrading to meet a changing workplace.

In terms of potential training, workshops, or seminars to offer their existing, incumbent workers, there is shared agreement between healthcare employers and industrial life sciences employers in two specific areas:

- Informatics-related skill upgrading for health and life sciences, including bioinformatic standards and concepts and electronic medical records; and
- Clinical trials management skill upgrading to both set up and conduct clinical trials involving a wide range of specialized activities, such as protocol development, institutional review board (IRB) approvals, patient recruitment, regulatory compliance, and privacy requirements, among other topics.

Interviews with health and life sciences industry executives also revealed an emerging need to help raise the skill levels of existing workers in understanding how insurance reimbursement is working under the ACA and the broader shift toward value-based health outcomes within healthcare. It is interesting to note that this skill set is important not just in healthcare organizations but also in biopharmaceutical and medical device companies moving new products into the marketplace.

In addition, industrial life sciences companies indicated technical skill-upgrading needs for existing workers in FDA regulatory approval processes for new products and FDA standards for GMP. These FDA standards continue to reflect changes in science as well as new approaches toward approval processes and standards. Traditional educational institutions do not often have the specialized expertise in regulatory sciences and affairs to be partners with industry, which makes this a difficult task for employers to meet.

Most revealing in the area of existing workforce skill upgrading is the need by health and life sciences employers to improve interpersonal and soft skills across their workforce in light of the changing workplace. These changes reflect a more diversified workforce in terms of sex and race, as well as big differences in attitudes and approaches among generations. But, the changing workforce also reflects emerging new business models requiring more teamwork and project management. The areas employers cited most often for “soft” skills upgrading of existing workforce include the following:

- Understanding how to manage and lead millennials;
- Managing and leading/adapting through change;
- Savvy with digital and social media;
- Government affairs/advocacy;
- Media skills/public speaking skills;
- Business, interpersonal, and communication skills;
- Solution/consultative selling;
- Project management;
- Critical and strategic thinking; and
- Financial management acumen.

The importance of these soft skills for existing workforce upgrading is also reflected by the observation from employers that, in developing workers with cross-functional and multidisciplinary competencies, they are more likely to bring along an employee with a background in a technical or scientific discipline and then to work to develop that employee’s business-related acumen and skill sets, rather than vice versa.

The Building Blocks for Future Actions: Indiana’s Ongoing Efforts

Existing workforce skill upgrading often falls through the cracks because it is not a typical focus of the workforce development system in the U.S. Novel industry-educational partnership approaches are often the hallmark of growing efforts for existing workforce skill upgrading, and Indiana has a number of examples, including the following:

- **Grace College Medical Device Quality Management.** Also in partnership with OrthoWorx, Grace College has a new five-course sequence focused in quality management that can be applied at the certificate, bachelor’s, or master’s levels. The courses utilize industry professionals with extensive experience and focus on critical components of quality management, including quality systems, postmarket surveillance, design control and assurance, manufacturing quality and supply chain management, and statistical processes.
- **Grace College ORCA.** In partnership with OrthoWorx in Warsaw and through its Center of Excellence in Orthopedics, Grace College offers “the nation’s only graduate program designed specifically by and for orthopedic regulatory and clinical affairs professionals.” The college offers both a graduate certificate and master’s level program with an accelerated design to complete in

1 year. The program is focused on developing a strong foundation and understanding in laws and regulations, particularly of the FDA related to orthopedic products. Specific courses are offered in introductory orthopedics, medical device law, writing for regulatory affairs, managing clinical data, good clinical practices, compliance, and clinical trial management and monitoring. The master's program graduated 13 in 2014.

Addressing Indiana's Unmet Strategic Needs: Drawing on National Best Practices and Industry Insights

Since existing workforce skill upgrading is not a traditional focus of either traditional educational efforts or workforce development, it is important to think about creating more systematic approaches that leverage assets found in the state. The following are among the efforts for Indiana to consider to target existing workforce skill upgrading in health and life sciences:

Establishing a statewide initiative that connects colleges and universities to address the technical and soft skill requirements of advancing technologies and changing workplaces. The idea would be to leverage all postsecondary institutions as key assets to work with industry, enabling scale to be reached across the state. One excellent example is the effort in North Carolina to establish for life sciences professionals an avenue to raise skill levels by leveraging broader postsecondary educational institution assets, through what is known as NCBioImpact. This is a joint undertaking of the state's dedicated biosciences development organization, NCBiotech, the North Carolina Biosciences Organization, the North Carolina Community College System, and the University of North Carolina System. Its objective is to work to ensure that North Carolina can meet the talent needs of the biopharmaceutical sector. NCBioImpact was created in 2003 with a grant from the Golden Leaf Foundation, which invests North Carolina's tobacco settlement funds in economic development initiatives. For existing workforce skill upgrading, NCBioImpact offers both short courses as well as certificate programs that can lead to future degrees, through three specific components:

- **Biomanufacturing Training and Education Center (BTEC)** is a specialized biomanufacturing training and education facility at North Carolina State University. The pilot-scale production plant provides advanced, hands-on training and education for students and current workers. BTEC is well regarded in its professional certificate programs involving a wide range of skills in upstream, downstream, and analytical technologies used in biomanufacturing, including GMP and specific skills in advanced techniques, such as cell culture engineering, chromatography, and assay development and validation.
- **Biomanufacturing Research Institute and Technology Enterprise (BRITE)**, located at North Carolina Central University, provides short courses designed for job seekers or current employees in the biotechnology sector who wish to enhance their skills through continuing education. BRITE's short courses with hands-on experience in instrumentation and equipment found in the workplace provide an efficient, cost-effective avenue for companies to retool existing employees to meet evolving product goals, or for job seekers to prepare themselves

to fill employment gaps in North Carolina's growing biotechnology industry. These professional development short courses are offered upon request with a minimum of six participants. Upon completing a short course, including a competency exam, participants receive continuing education units from North Carolina Central University, Division of Continuing Education.

- **BioNetwork** is a statewide initiative that connects more than 20 community colleges and includes specialized centers with training for specific aspects of biotechnology. It offers incumbent worker training, transitional worker training, and pre-employment classes on specific topics and skill sets, as well as supports the future biotechnology and life sciences workforce through teacher training and outreach.

Creating incentives and funding mechanisms for industry to place a priority on existing workforce skill upgrading. In a tight labor market, employers will often underfund workforce training because workers can move to other organizations once they have improved skills, which means that employers funding the training do not get the benefit. One way to work with employers to ensure that existing workforce skill upgrading is not overlooked is to create matching funds and specific incentives for them to undertake skill upgrading.

One long-standing approach is found in Iowa. The state offers employers a range of employee training options leveraging state withholding taxes paid on wages. For companies that are expanding, it offers a credit against payroll taxes paid for new positions being created to receive skill training of up to \$1,698 per employee (1.5 percent to 3 percent of the gross wages paid via Iowa state withholding taxes generated by new positions). Employers participating can be further eligible for reimbursement up to 50 percent of the annual gross payroll costs expended for on-the-job training and for a corporate tax credit if employment is increased by at least 10 percent. This credit averages approximately \$37 million annually and is tied to expanding businesses involved with serving customers out of state doing manufacturing, processing, and R&D, among other activities. There is no minimum number of jobs required, and most of the businesses receiving credits for new job skill training are small- and medium-sized firms. Grant funding is also available through annual appropriations of approximately \$4 million for skill upgrading without job creation for similar businesses serving out-of-state customers, for a consortium of businesses coming together to do skill training. In the case of Iowa, community colleges play a role in administering the participation of businesses for the credit and grant funding, though the colleges are not always involved in the training provided. This has created some controversy regarding the administrative costs of the program, but not its effectiveness for employers to have a ready source of skill-training support.

A more focused effort on serving a consortium of businesses within an industry sector in a specific region of a state to increase skill training can be found in Maryland. Through the EARN Initiative—previously noted as standing for Employment Advancement Right Now—grants are available to support regionally based, industry-led workforce development projects to address critical skill gaps needed for available jobs. EARN is oriented toward growing specific industry sectors through industry

partnerships that document need through an initial planning grant and then conduct the training through a follow-on implementation grant. An example is BIOTrain hosted at Montgomery College beginning in 2013 and focusing on a number of short courses that address the needs identified by biosciences companies in the county, including drug development, process improvement, and protein purification.

Raising Indiana's Ability to Attract and Retain Top Health and Life Sciences Talent

A Call to Action: Indiana's Strategic Needs

Perhaps the most difficult challenge facing Indiana and any state with a robust economic driver in the health and life sciences industry is the recruitment of top talent. Stated bluntly, top talent drives innovation that is critical to a growing and competitive health and life sciences industry. The market for top-talent positions in the health and life sciences is a national one. This sets top-talent positions apart from the more local job market involving low- and middle-skilled jobs, where local residents tend to fill most positions.

National recruiting, not surprisingly, is undertaken by the Indiana health and life sciences industry with a focus on higher-educated, higher-skilled jobs for physicians and surgeons, research scientists, health and bioinformatics, regulatory affairs, quality assurance, and even for registered nurses. Among the specific needs identified in these national searches are the following:

- Experienced scientists and executives;
- Scientists with technical and business savvy; “multidimensional”;
- Mechanical engineers, especially those with exposure to production; and
- Broad and increasing demand for “IT workers.”

Still, there are concerns that Indiana is not well positioned for attracting top talent. While the health and life sciences industry in Indiana is a leader in the use of top talent, such talent leadership is not the case across all Indiana industries. This creates a difficult dynamic for the health and life sciences sector. Indiana is simply not well recognized as a place for top-talent careers, even among recent college graduates. An aging of the life sciences workforce that affects not only the production side, but also the base of top scientific life sciences talent, is another concern.

Further complicating the recruitment of top life sciences talent is the business ecosystem of the health and life sciences industry in Indiana. The makeup of much of Indiana's life sciences industry among large, dominant firms across each subsector, a position envied by many other states and regions, is one that also can create a dynamic where a relative lack of peer firms in similar lines of business leads to challenges in finding talent. While there is certainly a base of established mid-sized organizations and emerging innovative ventures, this business ecosystem dominated by major employers makes

career pathways often appear to be far narrower and more linked to individual companies rather than to a broad industry cluster.

Consequently, it is not surprising that the survey of health and life sciences companies and follow-up interviews with corporate executives found that it is very difficult to hire top talent in areas such as research scientists and marketing and sales. A newly emerging concern across the health and life sciences industry is the recruitment of top talent in health/bioinformatics, which is becoming a critical driver for innovation going forward.

Still, Indiana does generate a significant level of top talent across its high-quality university base that can go a long way toward addressing the needs of the state's health and life sciences industry. But, current levels of outmigration of top talent across science, engineering, and computer sciences drive down the level of available top talent for Indiana's health and life sciences industry. Currently, the level of retention for key science, engineering, and IT graduates is quite low, even among in-state residents. Among graduates from 2009 to 2013 across Indiana's public colleges and universities:

- Only 33 percent of in-state biological science graduates (and 6 percent of out-of-state graduates) work in Indiana;
- Only 38 percent of in-state engineering graduates (and 6 percent of out-of-state graduates) work in Indiana; and
- Only 49 percent of in-state computer and information sciences graduates (and 5 percent of out-of-state graduates) work in Indiana.

By comparison, in the healthcare degree fields, more than 60 percent of in-state graduates, and nearly 10 percent of out-of-state graduates, work in Indiana.

Aggressive efforts to retain talent must be a priority for Indiana.

The Building Blocks for Future Actions: Indiana's Ongoing Efforts

There are several important initiatives that have been put in place within Indiana to address the retention of college talent, including the following:

- **Initiative to promote opportunities through educational collaborations.** For over the past decade, the Lilly Endowment has awarded grants to Indiana colleges and universities to pursue activities that improve the job prospects of college graduates in the state. In December 2013, the Lilly Endowment announced \$62.7 million in grants to Indiana's 39 accredited colleges and universities to boost efforts to enhance and expand opportunities for college graduates to find meaningful employment in Indiana. These grants were based on extensive planning efforts undertaken in 2012 in which each of Indiana's colleges and universities studied the

problem from the perspective of each institution’s mission and context, the experiences of their graduates in seeking employment in Indiana, and the development of school-specific strategies to address the initiative’s aim. These grant funds are enabling the schools to pursue a broad range of activities that span all points on the college-to-career spectrum, with strong ties to the biosciences as a leading industry sector in Indiana. Common strategies include the following: developing new courses, certificates, credentials and degrees; beginning more deliberate career counseling for all students during their freshman year rather than waiting until their junior or senior years; offering more internship and co-op opportunities; and strengthening efforts to promote entrepreneurship and technology transfer.

- **INTERNnet.** Since 2001 the Lilly Endowment has supported a web-based internship-matching program linking employers, students, and schools. It was initially launched by the Greater Indianapolis Chamber of Commerce in partnership with the University of Indianapolis and now operates as a non-profit organization, Indiana INTERNnet. It offers a dynamic, searchable database, matching and reporting system coupled with personal assistance—including a toll-free hotline to answer questions and provide internship guidance and resource materials. The goal is to help create or expand high-quality experiential opportunities within Indiana. Currently, over 6,000 employers and 17,000 students have registered and 1,300 active internship positions are listed.
- **The Orr Fellowship program** seeks to engage the top recent graduates of Indiana and Ohio universities in meaningful postgraduation experiences across a range of Indianapolis’ growth companies, including in the life sciences. The 2-year fellowships are highly competitive, and awarded fellows are provided a full-time, salaried position with “considerable responsibility”; continued learning opportunities in entrepreneurship, coding, and other workshops; executive-level mentoring and networking opportunities; and civic engagement. Feedback from at least one life sciences company is extremely positive and encouraging to scale up this type of comprehensive top-talent development initiative.

Addressing Indiana’s Unmet Strategic Needs: Drawing on National Best Practices and Industry Insights

Indiana needs to double down on its efforts to retain and attract talent, so that it can reach a tipping point where in-state and out-of-state recent graduates and experienced workers recognize the industry strengths and opportunities in health and life sciences found in Indiana. Indiana should consider the following efforts and examples:

Establishing incentives for attracting high-skilled life sciences innovation talent to Indiana to raise the state’s visibility. The state of Indiana should consider complementing the efforts of the Lilly Endowment working with higher education institutions and industry to create connections between students and employers, with a targeted high-skilled life sciences talent incentive program. The objective would be to focus on recruiting a select number of top-talent individuals who can establish

new innovative life sciences companies in Indiana or can lead product development efforts within existing companies.

One example is the effort in Oklahoma to bolster innovation and remain competitive in its aerospace industry by establishing the Aerospace Engineer Workforce Tax Credits, providing tax credits for up to 5 years to aerospace engineers and contractors as well as the hiring aerospace company. Aerospace companies hiring engineers in a variety of fields receive a tax credit equal to 5 percent of the compensation paid to an engineer or 10 percent if the engineer graduated from an Oklahoma college or university (up to \$12,500 per employee per year), plus another credit of up to 50 percent of the tuition reimbursed to an employee. Additionally, the engineer hired receives a tax credit of \$5,000 per year. The incentives began in 2009 and have been extended through 2018. The Oklahoma Tax Commission determined the credit had been claimed on 363 returns with a total cost to the state of \$950,000.²⁸

For attracting top life sciences innovation talent, there are a number of different incentive-type programs. One that is being utilized by leading industry clusters within a state or region is the accelerator model, which targets emerging young entrepreneurs in a particular field by providing them ways to “accelerate” their start-ups such as seed funding, access to mentors, connections to key strategic partners, access to facilities, and opportunities for follow-up funding. New York City has an accelerator in digital health, while Des Moines has one for new start-ups serving the global insurance industry. In the Des Moines case, the Global Insurance Accelerator was started in 2014 as an initiative of the Greater Des Moines Partnership and offers \$40,000 in seed funding as well as a mentor drawn from current and former industry executives from major carriers and brokerages located in Des Moines. To date, 12 entrepreneurial teams have been funded in annual rounds of 6 each year.

A unique talent retention program is to target recent foreign high-skilled, entrepreneurial-minded international graduate students. Currently, international students’ visas expire when they graduate. In order to stay in the U.S. they must find an employer willing to sponsor their H-1B visa application. However, there are only a limited number of H-1B visas available each year and the application process is challenging for emerging entrepreneurs. Still, higher education institutions are exempt from the H-1B cap and can apply for visas throughout the year. In Massachusetts, a Global Entrepreneur-in-Residence (GEIR) Program was initially conceived by venture capitalist and Harvard Business School professor Jeff Bussgang and immigration lawyer Jeffrey Goldman, and introduced by former governor Deval Patrick in 2014, but had its funding cut due to a budget deficit. However, Governor Charlie Baker, working with members of the innovation community, eventually reinstated \$100,000 to support the program as a public-private partnership. Currently, the program operates with both public and private funding as a demonstration effort at the University of Massachusetts, Boston. There, students work part-time with the university in their field of study and part-time on a new early-stage venture the foreign graduate student is helping to lead. Recent news reports announced that a major gift from

²⁸See http://www.tulsaworld.com/news/capitol_report/tax-credit-for-oklahoma-aerospace-engineers-extended/article_1330d-b3e-b463-11e3-ab1d-001a4bcf6878.html.

Silicon Valley Bank is helping to expand the UMass Boston program to 12 participating recent foreign graduate-student entrepreneurs. The first two global entrepreneurs in residence each raised more than \$2 million in funding since joining the GEIR program in 2014.²⁹

Creating translational life sciences research connections for Indiana graduate-student scientists and engineers with Indiana clinicians. The life sciences stand out not only because there is a major commitment by industry to R&D, but also because there are especially close ties between industry, clinical care, and academic communities due to the interface of “bench and bedside” required for biomedical innovation to move forward. This creates opportunities to better link science and engineering talent at universities to the clinical.

An excellent example is Stanford’s Program in Biodesign. This program began in 2000 with just a few faculty members and 3 staff, and now involves 20 faculty and a staff of 8. Over 300 students participate annually, including 16 to 20 fellowships for 1-year intensive effort on biomedical innovation, including interactions with clinicians and industry mentors. It offers students a project-based biomedical innovation course. Out of this effort have come 37 new start-up companies that have raised over \$325 million. On a smaller scale, the University of Utah’s bioDesign program creates a partnership between clinicians at the Health Sciences Center and student engineering teams, who are involved in a two-semester capstone design class where products are developed and prototyped using the guidance of FDA Design Control mandates. The clinicians supply the ideas, clinical relevancy, and mentoring while the student teams develop requirements, build prototypes, and conduct testing. All of the projects are based on new ideas or improvements for products. Projects have been wide ranging involving cardiology, speech pathology, rehabilitation, gastroenterology, cardiothoracic surgery, ophthalmology, neonatology, urology, and anesthesiology.

Focusing on place-making activities to attract and retain talent. Indiana has a significant opportunity to create an Innovation District at 16 Tech in downtown Indianapolis that can change the orientation and serve as a branding for the state to retain young talent in Indiana as well as attract top talent outside of Indiana. The Brookings Institution in a recent white paper on “The Rise of Innovation Districts: A New Geography of Innovation in America” suggests that these places where leading-edge anchor institutions and companies cluster and connect with start-ups, business incubators, and accelerators can be a key differentiator in attracting and retaining talent. As The Brookings Institution explains “Innovation districts are the manifestation of mega-trends altering the location preferences of people and firms and, in the process, re-conceiving the very link between economy shaping, place making and social networking.”³⁰ In an interesting paradox, the more globally integrated the world economy becomes, the more important local place-based developments are becoming as a competitive factor in a state’s success in creating a healthy innovation eco-system.

²⁹See https://www.umb.edu/news/detail/global_entrepreneur_in_residence_program_gets_first_corporate_partnership_w.

³⁰Bruce Katz and Julie Wagner, “The Rise of Innovation Districts: A New Geography of Innovation in America,” Brookings Institution, May 2014.

The initial wave of such Innovation District developments in urban areas, anchored by an academic medical center or university that combined live/work/play, took off in the early 2000s, including at NC State/Centennial Campus in Raleigh, South Lake Union in Seattle, Mission Bay in San Francisco, Georgia Tech's Technology Square in Midtown Atlanta, and Oregon Health and Science University in Portland. Newer developments include St. Louis Cortex and Wake Forest University's Piedmont Triad in Winston-Salem. Key features of these urban Innovation District developments anchored by academic medical centers and universities include the following:

- Establishing “livable urban settings” involving live/work/play activities in one location. These livable urban settings are seen as highly attractive to young faculty, postdocs, and graduate students.
- Supporting innovation-led industry growth as a component of development through planned multitenant facilities offering specialized lab and technology space.
- Ensuring the availability of substantial space for significant future research growth by universities, non-profit research institutions, and industry collaborators.
- Advancing innovation and talent initiatives that can help drive development, including access to technology business incubation services, facilitating relationships with faculty and major research centers/shared-use facilities, supporting internship programs, and increasingly providing direct technology commercialization services.
- Having a development organization in place to provide the innovation and talent services, market the Innovation District, and work with the variety of landowners and other stakeholders. Many of these development organizations have been organized as non-profit research parks, with close, but arm's-length relationships to anchor universities, academic medical centers, and industry sponsors and with their own separate board of directors.

For Indiana, 16 Tech is well positioned to take its place as a nationally recognized Innovation District, able to be a magnet for talent retention and attraction, particularly in the life sciences, by bringing together both a significant academic medical complex as well as a strong corporate presence in downtown Indy. IU Health stands out as an academic medical center, with nationally ranked clinical expertise that brings top talent, a strong connection to an academic research partner in IU School of Medicine, and a strong focus on innovation and collaboration with industry. Meanwhile, university research is substantial and outpacing national growth at the downtown campus of IU School of Medicine/IUPUI, ranking 33rd in the nation in medical sciences research spending. At the same time, there is a strong corporate life sciences research and innovation presence with the major R&D labs for Eli Lilly and the recent addition of the Cook Group with its growing cell therapy affiliate, Cook General BioTechnology, LLC and Cook Regentec. Anchoring the 16 Tech development, the Indiana Biosciences

Research Institute (IBRI), launched in 2013 as a statewide public-private partnership, offers a novel setting that engages and leverages industry and universities.

Conclusion

With success can come new challenges, as Indiana is reaping the rewards of a health and life sciences sector that is growing jobs and wages at rapid rates and is experiencing some of the associated growing pains of this success. Strong demand for skilled workers in the industry is putting pressure on and at times outstripping the supply of qualified workers. The assessment of demand and supply dynamics and how they align highlights challenging workforce dynamics that span both pillars of the industry—the industrial life sciences as well as healthcare. Current and potential new demand-supply imbalances occur across occupations that play key roles in each of the sectors as well as in some occupations that transcend the sectors such as IT, bioinformatics, quality control, and regulatory affairs.

To move forward, Indiana needs a comprehensive approach to address the full implications of the demand and supply assessment in ensuring the state has a robust talent base to meet the needs of the health and life sciences industry. This comprehensive approach requires addressing not only the longer-term efforts to generate homegrown talent in the state to meet the needs of industry, but also the near-term needs of industry for the skill upgrading of the existing health and life sciences workforce and the ability to compete in the national and international markets to attract and retain top-level scientific, engineering, and experienced management talent.

The key findings from this study lead to recommendations around four broad strategic priorities pursued through public-private partnership initiatives:

- **Ensuring a strong foundation of STEM skills to prepare for postsecondary education and lifelong learning required for careers in health and life sciences occupations.**
- **Fostering postsecondary talent generation in Indiana that promotes strong connections to career opportunities in health and life sciences.**
- **Upgrading the skills of Indiana’s incumbent health and life sciences workforce** to meet the changing skill demands of the fast-paced innovations and changing business models transforming the health and life sciences industry.
- **Raising Indiana’s ability to attract and to retain top health and life sciences talent** across the highly competitive national labor markets for scientific, engineering, and medical talent.

These recommendations and associated actions recognize numerous existing and effective efforts underway in Indiana and seek to leverage the energy and momentum in the state around workforce initiatives. Armed with a better understanding of the health and life sciences workforce and talent situation in Indiana and priority areas of focus and policy actions and examples that address critical gaps, industry stakeholders can proactively work toward solutions and ensure that talent continues to drive health and life sciences development in Indiana into a bright and prosperous future.

The background of the page is a solid blue color with a repeating pattern of white line-art icons representing various pieces of laboratory glassware. These icons include Erlenmeyer flasks, round-bottom flasks, test tubes, and beakers, some containing liquid and bubbles. The pattern is dense and covers the entire page.

Appendix

Appendix

Health and Life Sciences Workforce Advisory Committee Members and Focus Group Participants

BioStorage

Mike Reffeitt, Chief Financial Officer

Catheter Research Inc.

Elizabeth Stahl, Vice President, Human Resources

CICP

Jason Kloth, Executive Director, Workforce Initiative

Community Health Network, Inc.

Joyce Irwin, Community Health Network Foundation, President and Chief Executive Officer

Sam Siebu, Vice President

Edie Garriott, Human Resources Director

Nancy Foster, Executive Director, Human Resources

Cook Group

Dan Peterson, Vice President, Industry and Government Affairs

Covance

Vickie Neddenriep, Vice President, Global Human Resources

Shannon Burke, Senior Human Resources Business Partner

Dow AgroSciences

Kay Kuenker, Vice President, Government Affairs, Public Affairs and Sustainability (retired)

Eli Lilly and Company

Andy Dahlem, Vice President, Lilly Research Labs

Rob Smith, Senior Director, Corporate Responsibility

Eskenazi Health

Lee Ann Blue, Chief Nursing Officer

Indiana Hospital Association

Doug Leonard, President

Indiana University

Bill Stephan, Vice President Engagement

IU Health

Richard Chadderton, Senior Vice President, Engagement and Strategy

Ivy Tech

Sue Smith, Vice President, Technology Division

Calvin Thomas, Vice President, Health Division

Lawton Loop Consulting

Michael Gargano

Lilly Endowment

Clay Robbins, Chairman, President and Chief Executive Officer

Sara Cobb, Vice President

Medical Device Manufacturers Council

Kathy Heuer, Executive Director

OrthoWorx

Sheryl Conley, President and Chief Executive Officer

Brad Bishop, Executive Director

Purdue University

Julie Griffith, Vice President, Public Affairs

Richard M. Fairbanks Foundation

Claire Fiddian-Green, President and Chief Executive Officer

Roche Diagnostics

Bridget Boyle, Vice President, Human Resources

Rush Memorial Hospital

Brad Smith, President and Chief Executive Officer

Saint Vincent Health

Audra Pratt, Vice President, Human Resources

State of Indiana

David Shane, Region 5 Works Council

University of Notre Dame

Mary Galvin, Dean of Science

Occupational Definitions

The following tables include the detailed occupations that make up each major health and life sciences group.

SOC CODE	SOC TITLE
<i>Health Diagnosing & Treating Practitioners</i>	
29-1011	Chiropractors
29-1021	Dentists, General
29-1022	Oral and Maxillofacial Surgeons
29-1023	Orthodontists
29-1024	Prosthodontists
29-1029	Dentists, All Other Specialists
29-1031	Dietitians and Nutritionists
29-1041	Optometrists
29-1051	Pharmacists
29-1061	Anesthesiologists
29-1062	Family and General Practitioners
29-1063	Internists, General
29-1064	Obstetricians and Gynecologists
29-1065	Pediatricians, General
29-1066	Psychiatrists
29-1067	Surgeons
29-1069	Physicians and Surgeons, All Other
29-1071	Physician Assistants
29-1081	Podiatrists
29-1199	Health Diagnosing and Treating Practitioners, All Other
<i>Health Technologists & Technicians</i>	
29-2011	Medical and Clinical Laboratory Technologists
29-2012	Medical and Clinical Laboratory Technicians
29-2021	Dental Hygienists
29-2031	Cardiovascular Technologists and Technicians

SOC CODE	SOC TITLE
29-2032	Diagnostic Medical Sonographers
29-2033	Nuclear Medicine Technologists
29-2034	Radiologic Technologists
29-2035	Magnetic Resonance Imaging Technologists
29-2037	Radiologic Technologists and Technicians*
29-2041	Emergency Medical Technicians and Paramedics
29-2051	Dietetic Technicians
29-2052	Pharmacy Technicians
29-2053	Psychiatric Technicians
29-2054	Respiratory Therapy Technicians
29-2055	Surgical Technologists
29-2056	Veterinary Technologists and Technicians
29-2057	Ophthalmic Medical Technicians
29-2061	Licensed Practical and Licensed Vocational Nurses
29-2071	Medical Records and Health Information Technicians
29-2081	Opticians, Dispensing
29-2091	Orthotists and Prosthetists
29-2092	Hearing Aid Specialists
29-2099	Health Technologists and Technicians, All Other
<i>Healthcare Assistants & Support</i>	
31-1011	Home Health Aides
31-1012	Nursing Aides, Orderlies, and Attendants*
31-1013	Psychiatric Aides
31-1014	Nursing Assistants
31-1015	Orderlies
31-2011	Occupational Therapy Assistants

SOC CODE	SOC TITLE
31-2012	Occupational Therapy Aides
31-2021	Physical Therapist Assistants
31-2022	Physical Therapist Aides
31-9011	Massage Therapists
31-9091	Dental Assistants
31-9092	Medical Assistants
31-9093	Medical Equipment Preparers
31-9094	Medical Transcriptionists
31-9095	Pharmacy Aides
31-9096	Veterinary Assistants and Laboratory Animal Caretakers
31-9097	Phlebotomists
31-9099	Healthcare Support Workers, All Other
<i>IT Occupations</i>	
15-1111	Computer and Information Research Scientists
15-1121	Computer Systems Analysts
15-1122	Information Security Analysts
15-1131	Computer Programmers
15-1132	Software Developers, Applications
15-1133	Software Developers, Systems Software
15-1134	Web Developers
15-1141	Database Administrators
15-1142	Network and Computer Systems Administrators
15-1143	Computer Network Architects
15-1150	Computer Support Specialists
15-1151	Computer User Support Specialists
15-1152	Computer Network Support Specialists
15-1199	Computer Occupations, All Other
17-2061	Computer Hardware Engineers

SOC CODE	SOC TITLE
<i>Life Sciences-related Engineers</i>	
17-2021	Agricultural Engineers
17-2031	Biomedical Engineers
17-2112	Industrial Engineers
17-2131	Materials Engineers
17-2141	Mechanical Engineers
<i>Life Sciences-related Technicians</i>	
17-3026	Industrial Engineering Technicians
17-3027	Mechanical Engineering Technicians
19-4011	Agricultural and Food Science Technicians
19-4021	Biological Technicians
19-4031	Chemical Technicians
51-9081	Dental Laboratory Technicians
51-9082	Medical Appliance Technicians
51-9083	Ophthalmic Laboratory Technicians
<i>Life Sciences Managers</i>	
11-9111	Medical and Health Services Managers
11-9121	Natural Sciences Managers
<i>Life Scientists</i>	
19-1011	Animal Scientists
19-1012	Food Scientists and Technologists
19-1013	Soil and Plant Scientists
19-1021	Biochemists and Biophysicists
19-1022	Microbiologists
19-1029	Biological Scientists, All Other
19-1041	Epidemiologists
19-1042	Medical Scientists, Except Epidemiologists
<i>Nursing</i>	
29-1141	Registered Nurses

SOC CODE	SOC TITLE
29-1151	Nurse Anesthetists
29-1161	Nurse Midwives
29-1171	Nurse Practitioners
<i>Therapists</i>	
29-1121	Audiologists
29-1122	Occupational Therapists
29-1123	Physical Therapists
29-1124	Radiation Therapists
29-1125	Recreational Therapists
29-1126	Respiratory Therapists
29-1127	Speech-Language Pathologists
29-1128	Exercise Physiologists
29-1129	Therapists, All Other
29-1181	Audiologists
<i>Skilled Industrial Production & Support*</i>	
11-3051	Industrial Production Managers
11-9199	Managers, All Other
11-1021	General and Operations Managers
13-1041	Compliance Officers
13-1199	Business Operations Specialists, All Other
13-2011	Accountants and Auditors
17-2041	Chemical Engineers
19-2031	Chemists
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products
41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products
43-3031	Bookkeeping, Accounting, and Auditing Clerks
43-4051	Customer Service Representatives
43-5061	Production, Planning, and Expediting Clerks
43-5071	Shipping, Receiving, and Traffic Clerks

SOC CODE	SOC TITLE
43-5081	Stock Clerks and Order Fillers
43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive
43-9061	Office Clerks, General
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers
49-9041	Industrial Machinery Mechanics
49-9071	Maintenance and Repair Workers, General
51-1011	First-Line Supervisors of Production and Operating Workers
51-2092	Team Assemblers
51-2099	Assemblers and Fabricators, All Other
51-4041	Machinists
51-4072	Molding, Coremaking, and Casting Machine Setters, Operators, and Tenders, Metal and Plastic
51-4081	Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic
51-6031	Sewing Machine Operators
51-8091	Chemical Plant and System Operators
51-9011	Chemical Equipment Operators and Tenders
51-9012	Separating, Filtering, Clarifying, Precipitating, and Still Machine Setters, Operators, and Tenders
51-9023	Mixing and Blending Machine Setters, Operators, and Tenders
51-9041	Extruding, Forming, Pressing, and Compacting Machine Setters, Operators, and Tenders
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers
51-9111	Packaging and Filling Machine Operators and Tenders
53-3032	Heavy and Tractor-Trailer Truck Drivers
53-3033	Light Truck or Delivery Services Drivers
53-7051	Industrial Truck and Tractor Operators
53-7062	Laborers and Freight, Stock, and Material Movers, Hand

**Note: Skilled Industrial Production and Support Occupations were identified for the Life Sciences by examining national "Staffing Patterns" data that show occupational employment by industry. These occupations make up at least 1 percent of employment in Pharmaceutical, Medical Device, and/or Agricultural Chemicals production and that share of employment exceeds their share of employment in all of manufacturing—hence, these occupations and skill sets play a key role in the Life Sciences manufacturing sector(s).*

Healthcare Assistants & Support

Key Subsectors: Healthcare

Identified Supply-Demand Alignment Challenges/Concerns:

None identified; overall demand has been weak during recovery.

Demand Side

Employment: Declining, Average Concentration

- **Size:** 80,600
- **Trend (2010-14):** -5%; slower than US
- **Specialization:** Average, LQ is 0.95
- **Specialized Components:** Psychiatric Aides, Orderlies, Occ Therapy Assistants, Physical Therapy Assistants

Projected Annual Need (by DWD):

- 3,517 (56% New Jobs)

Initial Surveys Indicate:

- Recent Hires (last yr): 451
- Current Vacancies: N/A
- Expected Hires (next 2 yrs): N/A

Supply Side

Degree Level & Experience Required (Minimum):

- Varied – No diploma thru BA
- Varied – Educ. Only; Work Exp.

Recruitment Geography:

- Local, Midwest Region

Key IN Postsecondary Programs/Institutions:

- Associate's Level: Medical/Clinical Assistant; Health Aide; PT Tech/Asst; Occupational Therapy Asst; Dental Assistant
- Ivy Tech (all areas); Brown Mackie College (several campuses); Harrison College-Indy (Medical Asst)

Manufacturing & Production

Key Subsectors: Agbio, Drugs & Pharma, Medical Devices

Identified Supply-Demand Alignment Challenges/Concerns:

Many concerns regarding availability of quality operators/production workers; challenges include basic math skills, employability issues, career awareness; high volume required with High School + Certificate or OJT.

Demand Side

Employment: Broadly Defined = High-growth, Specialized Concentration

- **Size:** N/A for Life Sciences
- **Trend (2010-14):** 11%; outpacing US
- **Specialization:** Specialized, LQ is 1.16
- **Specialized Components (Broadly Defined):** Ind. Production Managers; Chemists; Ship/Receiving Clerks; Ind. Machinery Mechanics; Assemblers; Machinists; Molding/Casting Machine Setters; Sewing Machine Ops; Mixing/Blending; Inspectors/Testers; Packaging/Filling Ops; Truck Drivers; Laborers/Material Movers

Projected Annual Need (by DWD):

- 22K, All Industries (66% Replacements)

Initial Surveys Indicate:

- Recent Hires (last yr): 555
- Current Vacancies: 242
- Expected Hires (next 2 yrs): 925

Supply Side

Degree Level & Experience Required (Minimum):

- High School, Associate's, BA
- Primarily Education Only

Recruitment Geography:

- Local

Key IN Postsecondary Programs/Institutions:

- Chemistry, Chemical Eng, Accounting, Admin. Assistant, Operations Mgmt, Sales & Selling, Quality Control Tech, Machine Tool Technology
- Purdue (several areas); Rose-Hulman; Notre Dame; Grace College (QC); IU; IUPUI; Ivy Tech (Machine Tools, Admin. Asst)

Health Technologists & Technicians

Key Subsectors: Healthcare

Identified Supply-Demand Alignment Challenges/Concerns:

Generally difficult to find lab techs, requires career awareness (though “CSI Effect” is helpful); radiological techs, surgical techs particularly difficult and in-demand; new demand for genetic counseling.

Demand Side

Employment: Well concentrated, slower growth

- **Size:** 68,770
- **Trend (2010-14):** 1%; slower than US
- **Specialization:** Concentrated, LQ is 1.1
- **Specialized Components:** Medical & Clinical Lab Techs, Dental Hygienists, Licensed Practical Nurses, Opticians, Orthotists & Prosthetists

Projected Annual Need (by DWD):

- 2,842 (51% New Jobs)

Initial Surveys Indicate:

- Recent Hires (last yr): 195
- Current Vacancies: 26
- Expected Hires (next 2 yrs): 39

Supply Side

Degree Level & Experience Required (Minimum):

- Certificates, Associate’s, BA
- Education only, Some Work Exp.

Recruitment Geography:

- Local, Statewide, Midwest Region

Key IN Postsecondary Programs/Institutions:

- Vet/Animal Health Tech; Radiologic Tech; Surgical Tech; LPN; Respiratory Care Therapy; EMT Paramedic; Medical Insurance Coding; Dietitians; Medical Radiologic Tech
- Ivy Tech (many areas); MedTech College (Med Coding; LPN); IUPUI (Radiology); Harrison College-Indy (Vet Tech); Ball State (Dietetics)

Life Science-related Technicians

Key Subsectors: Agbio, Drugs & Pharma, Medical Devices, R&D

Identified Supply-Demand Alignment Challenges/Concerns:

None identified; generally seen as a strength.

Demand Side

Employment: High-growth, Specialized Concentration

- **Size:** 9,500
- **Trend (2010-14):** 11%; outpacing US
- **Specialization:** Specialized, LQ is 1.28
- **Specialized Components:** Engineering Technicians (Industrial; Mechanical); Ag & Food Science Techs; Biological Techs

Projected Annual Need (by DWD):

- 317 (72% Replacements)

Initial Surveys Indicate:

- Recent Hires (last yr): 43
- Current Vacancies: 15
- Expected Hires (next 2 yrs): 119

Supply Side

Degree Level & Experience Required (Minimum):

- Associate’s, BA
- Varied - Educ. Only; Work Exp.

Recruitment Geography:

- Local, Midwest Region

Key IN Postsecondary Programs/Institutions:

- Mechanical Eng. Technology, Manufacturing Eng. Technology, Industrial Technology, Eng/Ind. Mgmt, Biology Tech, Biotechnology Lab Tech
- Ivy Tech (all areas); Purdue (Main & Calumet); Ball State; Vincennes Univ; IUPUI-Ft. Wayne; IUPUI

IT Occupations

Key Subsectors: All Life Sciences

Identified Supply-Demand Alignment Challenges/Concerns:

Major Challenges Identified throughout Life Sciences. Hospitals high-demand for medical coding plus higher-end systems demands (databases; EPIC, Cerner EHR systems, etc.); health and bio-informatics in high-demand and difficult to find; managing patient, clinical trials data; increasing complexity of “connected” devices/monitoring; Precision Ag-related Big Data/analytics, sequencing.

Demand Side

Employment: Growing, Below-Average Concentration

- **Size:** 49,500 (Broad Concept, Not Life Science Specific)
- **Trend (2010-14):** 10%; slower than US
- **Specialization:** Below-Avg., LQ is 0.61
- **Specialized Components:** None.

Projected Annual Need (by DWD):

- 1,330 (57% Replacements); Broad Concept, Not L.S. Specific

Initial Surveys Indicate:

- N/A. Broad concept of IT not requested in survey.

Supply Side

Degree Level & Experience Required (Minimum):

- Varied – Associates/Certs thru BA/MA
- Varied – Educ. Only; Work Exp.

Recruitment Geography:

- Local, Statewide, Midwest Region

Key IN Postsecondary Programs/Institutions:

- Computer science; Informatics; Mgmt. Information Systems; Information Technology; Computer Engineering; CIS Security; Computer Graphics
- IU-Bloomington; Purdue; Ivy Tech; Notre Dame; Ball State; Rose-Hulman; ITT Tech
- Medical Insurance Coding – MedTech College

Nursing

Key Subsectors: Healthcare

Identified Supply-Demand Alignment Challenges/Concerns:

Major concerns among hospitals/health systems include: aging workforce, pending retirements, high volumes required, competition vs. outpatient centers, clinical residency capacity limits, experience required for ER/OR/Pediatric, increased educational requirements, shifting focus to value-based outcomes & team-oriented approaches.

Demand Side

Employment: Concentrated, slower growth

- **Size:** 63,460
- **Trend (2010-14):** 5%; slower than US (Identified IN “Cutbacks” recent yrs)
- **Specialization:** Concentrated, LQ is 1.04
- **Specialized Components:** Nurse Practitioners

Projected Annual Need (by DWD):

- 2,375 (52% Replacements)

Initial Surveys Indicate:

- Recent Hires (last yr): 1,896
- Current Vacancies: N/A
- Expected Hires (next 2 yrs): N/A

Supply Side

Degree Level & Experience Required (Minimum):

- Associate’s, BA, MA (Increasing)
- Varied – Educ. only, Occupational Work Experience

Recruitment Geography:

- Local, National

Key IN Postsecondary Programs/Institutions:

- Collaborations between St. Vincent’s-Marian Univ; Community-Ball State
- Ivy Tech; Purdue; IU; IN Wesleyan; Indiana State; Univ. of Southern Indiana

Quality Assurance/Control

Key Subsectors: All

Identified Supply-Demand Alignment Challenges/Concerns:

Identified as "very difficult" to find qualified candidates particularly in Medical Devices; first cohorts of grads out of new Quality Management program at Grace College.

Demand Side

Employment: Info limited to initial surveys

- **Size:** 651 (preliminary)
- **Trend (2010-14):** N/A
- **Specialization:** N/A
- **Specialized Components:**
Inspectors/Testers, Industrial Engineers and Technicians

Projected Annual Need (by DWD):

- N/A

Initial Surveys Indicate:

- Recent Hires (last yr): 49
- Current Vacancies: 38
- Expected Hires (next 2 yrs): 92

Supply Side

Degree Level & Experience Required (Minimum):

- BA
- Education + Relevant Work Exp.

Recruitment Geography:

- Statewide, Midwest, National

Key IN Postsecondary Programs/Institutions:

- New Grace College Quality Mgmt. program – Master's (13 Grads 2014)
- Ivy Tech Orthopedic Quality Standards Certificate

Regulatory Affairs

Key Subsectors: All

Identified Supply-Demand Alignment Challenges/Concerns:

Strong demand for experienced talent. Not a traditional, formal academic discipline so noted as most often learned on the job, within the company/industry. Grace College-OrthoWorx partner for grad program.

Demand Side

Employment: Info limited to initial surveys

- **Size:** 552 (Preliminary)
- **Trend (2010-14):** N/A
- **Specialization:** N/A
- **Specialized Components:** N/A

Projected Annual Need (by DWD):

- N/A

Initial Surveys Indicate:

- Recent Hires (last yr): 28
- Current Vacancies: 10
- Expected Hires (next 2 yrs): 40

Supply Side

Degree Level & Experience Required (Minimum):

- BA, MA
- Education + Technical Work Exp.

Recruitment Geography:

- National

Key IN Postsecondary Programs/Institutions:

- Grace College's Orthopaedic Regulatory and Clinical Affairs (ORCA) program – offers an MS degree or Graduate Certificate; partnership with OrthoWorx; nation's only grad program with this design/focus.

Health/Bio Informatics

Key Subsectors: All

Identified Supply-Demand Alignment Challenges/Concerns:

High-Demand & Challenging. Seen by all subsectors as key emerging technology and workforce area; identified as “very difficult” to find qualified candidates; viewed as critical area for incumbent worker training.

Demand Side

Employment: Info limited to initial surveys

- **Size:** 74 (Preliminary)
- **Trend (2010-14):** N/A
- **Specialization:** N/A
- **Specialized Components:** N/A

Projected Annual Need (by DWD):

- N/A

Initial Surveys Indicate:

- Recent Hires (last yr): 7
- Current Vacancies: 3
- Expected Hires (next 2 yrs): 6

Supply Side

Degree Level & Experience Required (Minimum):

- BA, MA
- Education + Technical Work Exp.

Recruitment Geography:

- National

Key IN Postsecondary Programs/Institutions:

- Bioinformatics, Medical Informatics, Informatics, Math/Statistics, Biomathematics
- IU-Bloomington School of Informatics & Computing, IUPUI (Bio- and Medical Informatics)

Life Science-related Engineers

Key Subsectors: Agbio, Drugs & Pharma, Medical Devices

Identified Supply-Demand Alignment Challenges/Concerns:

Identified as “Very difficult” to find qualified candidates; strong demand in Medical Devices for Mechanical Engineering talent for Orthopedic companies.

Demand Side

Employment: High-growth, Highly Specialized

- **Size:** 20,650 (broad concept)
- **Trend (2010-14):** 34%; outpacing US
- **Specialization:** Specialized, LQ is 1.73
- **Specialized Components:** Biomedical, Industrial, Materials, Mechanical

Projected Annual Need (by DWD):

- 769 (82% Replacements)

Initial Surveys Indicate:

- Recent Hires (last yr): 73
- Current Vacancies: 41
- Expected Hires (next 2 yrs): 92

Supply Side

Degree Level & Experience Required (Minimum):

- BA or MA+
- Varies – Educ. Only; Work Exp.

Recruitment Geography:

- Local, Statewide, Many National

Key IN Postsecondary Programs/Institutions:

- Mechanical, Industrial, Biomedical, Ag, Materials
- Purdue (in all areas); Rose-Hulman (Biomed, Mechanical); IUPUI (Biomed, Mechanical); Notre Dame (Mechanical)

Clinical Trial Coordinator

Key Subsectors: Drugs & Pharma, Medical Devices, R&D, Hospitals

Identified Supply-Demand Alignment Challenges/Concerns:

Identified as “very difficult” to find qualified candidates; demand by industry for incumbent worker training.

Demand Side

Employment: Info limited to initial surveys

- **Size:** 277 (Preliminary)
- **Trend (2010-14):** N/A
- **Specialization:** N/A
- **Specialized Components:** N/A

Projected Annual Need (by DWD):

- N/A

Initial Surveys Indicate:

- Recent Hires (last yr): 27
- Current Vacancies: 54
- Expected Hires (next 2 yrs): 124

Supply Side

Degree Level & Experience Required (Minimum):

- BA, MA, PhD
- Education + Technical Work Exp.

Recruitment Geography:

- National, Midwest Region

Key IN Postsecondary Programs/Institutions:

- Not a traditional degree field; often are drawn from nursing professions
- Grace College's Orthopaedic Regulatory and Clinical Affairs (ORCA) program has a core focus in key areas of clinical trials with Ortho focus including monitoring/auditing; management; GCP; managing trials data; writing.

Therapists

Key Subsectors: Healthcare

Identified Supply-Demand Alignment Challenges/Concerns:

None identified.

Demand Side

Employment: Growing, Well Concentrated

- **Size:** 14,490
- **Trend (2010-14):** 8%; just slower than US
- **Specialization:** Concentrated, LQ is 1.08
- **Specialized Components:** Radiation, Respiratory, Exercise Physiologists, Therapists “All other”

Projected Annual Need (by DWD):

- 565 (56% New Jobs)

Initial Surveys Indicate:

- N/A. Therapists included within larger “Diagnosing & Treating” group in survey.

Supply Side

Degree Level & Experience Required (Minimum):

- N/A. Therapists included within larger “Diagnosing & Treating” group in survey.

Recruitment Geography:

- N/A. Therapists included within larger “Diagnosing & Treating” group in survey.

Key IN Postsecondary Programs/Institutions:

- Kinesiology & Exercise Science; Audiology & Speech Pathology; Physical Therapy; Occ. Therapy; Radiation Therapy; Respiratory Therapy
- IUPUI (several areas); IU-Bloomington; Purdue; Univ. of Indianapolis (Occ, Phys Therapy); USI

Life Scientists/Research Scientists:

Key Subsectors: All, though limited in Health Systems

Identified Supply-Demand Alignment Challenges/Concerns:

Multiple companies identify as “very difficult” to find qualified candidates; relocating to Indiana a challenge.

Demand Side

Employment: High-growth but below-average concentration

- **Size:** 3,250
- **Trend (2010-14):** 53%; outpacing US
- **Specialization:** Under-concentrated, LQ is 0.68
- **Specialized Components:** Biochemists & Biophysicists

Projected Annual Need (by DWD):

- 150 (60% Replacements)

Initial Surveys Indicate:

- Recent Hires (last yr): 118
- Current Vacancies: 105
- Expected Hires (next 2 yrs): 227

Supply Side

Degree Level & Experience Required (Minimum):

- Mostly MA+, some BA
- Education + Relevant Experience

Recruitment Geography:

- National

Key IN Postsecondary Programs/Institutions:

- Master's Level Focus: Biology/Biological Sciences; Biochemistry; Cell Physiology; Soil Science/Agronomy; Food Science; Animal Science
- IU, Purdue, Notre Dame, IUPUI (Med. Scientist, Neuro, Pharmacology, Genetics)

Health Diagnosing & Treating Practitioners

Key Subsectors: Healthcare

Identified Supply-Demand Alignment Challenges/Concerns:

Challenging dynamics identified. Shifts to value-based outcomes focus, team-oriented approaches, customer service emphasis, soft skills increasing focus, ability to leverage IT, electronic medical records, preference for fewer/no “on-call” shifts.

Demand Side

Employment: High-growth, Average Concentration

- **Size:** 27,540
- **Trend (2010-14):** 13%; outpacing US
- **Specialization:** Average, LQ is 0.99
- **Specialized Components:** Orthodontists, Physicians & Surgeons “All other”

Projected Annual Need (by DWD):

- 1,187 (50% Replacements)

Initial Surveys Indicate:

- Recent Hires (last yr): 572
- Current Vacancies: N/A
- Expected Hires (next 2 yrs): N/A

Supply Side

Degree Level & Experience Required (Minimum):

- Varied – MA, MD
- Varied – Educ. Only; Technical Work Exp.

Recruitment Geography:

- National (Physicians, others), Local

Key IN Postsecondary Programs/Institutions:

- Medicine, Pharmacy, Phys. Assistant, Dietetics, Dentistry, Optometry, Pharmaceuticals & Drug Design
- Medicine: IUPUI; 2nd medical school at Marian Univ. opened (2013) ready to enter residency
- Butler (PA, Pharmacy); IUPUI (Dentistry); Purdue (Pharmacy); IU-Bloomington (Optometry)

