*Pharmacy* **2014**, *2*, 1-16; doi:10.3390/pharmacy2010001

OPEN ACCESS

*pharmacy*

**ISSN 2226-4787**

www.mdpi.com/journal/pharmacy

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# Availability, Uniqueness and Perceived Value of Bachelor of Science in Pharmaceutical Sciences (BSPS) Programs in the United States

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*Received: 12 September 2013; in revised form: 15 November 2013 / Accepted: 22 November 2013 / Published: 31 December 2013*

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**Abstract:** We describe the uniqueness of the Bachelor of Science in Pharmaceutical Sciences (BSPS) degree and the factors that contribute to this uniqueness. A total of 18 colleges and schools that offer a BSPS were identified in the literature and compared. A review of the current literature and university websites was conducted in order to compare and contrast the different BSPS programs. BSPS program directors' perceptions were evaluated through a 14-item online survey instrument. Of the 16 programs surveyed, seven (43.8%) responded to the survey. The respondents agreed that most of the BSPS graduates are placed (from the highest to the lowest) at pharmacy school, postgraduate education and in the pharmaceutical industry. This is a timely review of coursework, program lengths and job opportunities for graduates of the BSPS. Currently, the BSPS programs have yet to receive a large amount of attention, but the importance in pharmaceutical education cannot be denied.

**Keywords:** Bachelor of Science in Pharmaceutical Sciences; Bachelor of Science in Pharmacy; Doctor of Pharmacy degree; pharmaceutical education; pharmacy curriculum; Accreditation Council for Pharmacy Education

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## 1. Introduction

The first Bachelor of Science in Pharmaceutical Sciences (BSPS) degree program in the USA was initiated in 1962 at the University at Buffalo School of Pharmacy and Pharmaceutical Sciences [1]. Since then, 18 BSPS programs in the USA have come about, with the most recent program initiated in 2010 at the University of Rhode Island College of Pharmacy [2].

According to the Ohio State University College of Pharmacy, "the BSPS program provides students with a general education curriculum, classes in core sciences and foundational courses in the pharmaceutical sciences. It is a 4-year, non-licensure, undergraduate bachelor's degree program" [3]. Students who pursue a BSPS degree today are typically interested in areas of drug discovery, drug delivery, drug action and the manufacturing and marketing of pharmaceuticals. Upon graduating with the BSPS, students are not eligible to become licensed pharmacists. The BSPS curriculum helps in honing the requisite skills needed to develop and evaluate drug products through research in a variety of biotechnology and pharmaceutical facilities. Graduates typically work in the pharmaceutical industry or pursue higher education in areas related to pharmaceuticals, such as pharmacy [4]. The Accreditation Council for Pharmacy Education (ACPE) is the national agency for the accreditation of professional degree programs in pharmacy. Since the BSPS degree programs are not considered professional degrees, they are not accredited by the ACPE. The objectives of this study are two-fold: To distinguish the BSPS program from the PharmD and BSPharm programs by describing the educational and vocational characteristics for the BSPS programs in the USA (curriculum comparisons, job opportunities and satisfaction); to ascertain the program directors' perceptions regarding the BSPS programs that they operate. To accomplish these objectives, program directors were surveyed, and the available literature was assessed on the BSPS degrees offered by colleges in the USA.

### *Comparisons between BSPharm, BSPS and PharmD*

In July 1992, the ACPE mandated that all applicants entering the field of pharmacy had to obtain a Doctor of Pharmacy (PharmD) degree in order to become a licensed pharmacist [5]. As the switch from the BSPharm to PharmD was made, the Bachelor of Science in Pharmaceutical Sciences (BSPS) degree evolved from the previous BSPharm curriculum. The BSPS may be mistakenly equated as the former BSPharm degree or the PharmD degree. June 30, 2005 marked the official expiration of the ACPE standards for the baccalaureate degree (BS) in Pharmacy. During the 2004/05 academic year Purdue, Wayne State, St. Louis, St. John's, Albany, Ohio Northern and Utah were the remaining schools that conferred BSPharm degrees prior to the expiration (Melinda D. Colon, AACP email, June 17, 2013). The transition to the new policy was completed when the last Bachelor of Science (BS) in Pharmacy degree candidates graduated in 2005 at Ohio Northern University [6]. Current practicing pharmacists in the USA have either a PharmD or BSPharm degree. Today, students must graduate from a PharmD program and successfully complete the licensure process in order to become a practicing pharmacist. Currently, there are no BS in Pharmacy degree programs in the United States, because most of the BSPharm programs morphed into PharmD or what we now know as the BSPS [4].

In order to better understand the difference between the PharmD, the BSPharm and the BSPS degree, an introspection of the history and required curriculum for each of these degrees is required. In

the 1950s, basic sciences became an integral part of the education of pharmacists. At that time, practicing pharmacists played a role in influencing the curriculum being taught. The central attention of pharmacy practice was on the medications the pharmacist was dispensing; hence, the focus of education followed the focus of practice. The foundation of the curriculum was pharmaceutics, pharmacology and medicinal chemistry. Research also became an important component in the education of pharmacists [7].

In the past, there had been a component of apprenticeship or interning that taught the pharmacist much needed practical skills of the profession, standardized nationally by the National Association of Boards of Pharmacy. The PharmD degree evolved from the idea that a pharmacist needed both basic science knowledge and specialized patient care skills in order to become a well-rounded practicing pharmacist [3]. Yet, in its early years, clinical pharmacy was an educational experiment that led to increasing diversity rather than standardization in the clerkship experiences in various states. The American Council on Pharmaceutical Education (ACPE) began to promote the concept that clinical clerkships within the curriculum should be utilized to satisfy state and national internship requirements. With the advent of pharmaceutical care, changes in education and training became necessary for pharmacists to gain the skills needed for this evolving practice role [8]. Pharmaceutical care moved the emphasis from medications to the patient, along with the patient's drug therapy that directly affects their health [8].

Relative to Doctor of Pharmacy degree programs, the BSPS is currently offered at 18 colleges and universities in the United States. Information on the BSPS programs is available from the American Association of Pharmaceutical Scientists (AAPS) website and is presented in Table 1.

**Table 1.** Comparisons of the Bachelor of Science in Pharmaceutical Sciences (BSPS) programs at USA institutions.

| Name of University | Type of School or Department | Name of Program | Standalone or entry level to PharmD program | Number of Credit Hours |
|---|---|---|---|---|
| Albany College of Pharmacy and Health Sciences [9] | Pharmacy and Health Sciences | BSPS | Standalone | 133 h |
| Campbell University [10] | College of Pharmacy and Health Sciences | BSPS | Standalone<br>Prior to entering the BSPS, 64 h are to be completed. | 131.5–133.5 h |
| Cleveland State University [11] | College of Sciences and Health Professions | BSPS (three tracks under the BSPS Program)<br>-Pharmaceutical Chemistry Analysis<br>-Medicinal and Biological Chemistry<br>Pharmacy Administration | Standalone | 128 h |

**Table 1.** *Cont.*

| Name of University | Type of School or Department | Name of Program | Standalone or entry level to PharmD program | Number of Credit Hours |
|---|---|---|---|---|
| Elizabeth City State [12] | Department of Pharmacy and Health Professions | BSPS | Standalone | 128 h |
| Fairleigh Dickinson University [13,14] | School of Natural Science | -BS/MS# Chemistry w/ Pharmaceutical Chemistry concentration<br>-BS in Mathematics with Pharmaceutical Biostatistics concentration | 5 years program that awards both degrees<br>Standalone | 128 h for BS 151 h for MS |
| Massachusetts College of Pharmacy and Health Sciences University [15,16] | School of Pharmacy | -BSPS<br>-BSPharmacology andToxicology | Standalone<br>Standalone | 127 h<br>129 h |
| Michigan Technological University [17] | Department of Chemistry | Pharmaceutical Chemistry | Standalone | 128 h |
| Pittsburg State University [18] | College of Arts and Sciences | BS in Chemistry with Emphasis in Pharmaceutical Chemistry | Standalone | 124 h |
| Purdue University [19] | College of Pharmacy | BSPS | Standalone | 128 h |
| South Dakota State University [20] * | College of Pharmacy | BSPS | Awarded the BSPS degree after completing the first two years of pharmacy school | 90 h |
| Ohio State University [3] | College of Pharmacy | BSPS | Standalone Complete 45 h before admission to PharmD program | 108–120 h |
| University at Buffalo [1] | School of Pharmacy and Pharmaceutical Sciences | -BSPS<br>-BS Pharmacology and Toxicology | Standalone<br>MS in 5 years in conjunction with BS | 120 h<br>120 h |
| University of California, Davis [21] | Department of Chemistry | BS Pharmaceutical Chemistry | Standalone | 180 h |
| University of California, Irvine [22] | College of Health Sciences | BSPS | Standalone | 180 h |
| University of Connecticut [23] | School of Pharmacy | BS Pharmacy Studies | Awarded after the completion of two years of pre-pharmacy and the first two years of the pharmacy study in the professional program | 137 h |

**Table 1.** *Cont.*

| Name of University | Type of School or Department | Name of Program | Standalone or entry level to PharmD program | Number of Credit Hours |
|---|---|---|---|---|
| University of Delaware [24] | Collaboration with Thomas Jefferson University School of Pharmacy | BS Biological Science/ Pharmaceutical Sciences | First 3 years at UD; Fourth year is 1st year at TJU PharmD program | 132 h |
| University of Georgia [25] | College of Pharmacy | Pharmaceutical and Biomedical Sciences | Standalone | 120 h |
| University of Houston [26]^ | College of Pharmacy | BSPS | Standalone | 120 h |
| University of Michigan [27] | College of Pharmacy | BSPS<br>-Pharmaceutics<br>-Pharmacology<br>-Pharmacognosy<br>-Pharmaceutical Analytical Chemistry | Standalone Admitted to the Pharmacy School after spending two years of pre-pharmacy study (60 h) | 122 |
| University of Mississippi [28] | School of Pharmacy | BSPS | Required for PharmD admission | 113 h |
| University of North Carolina–Chapel Hill [29] | College of Pharmacy | BSPS | BSPS program is the P1–P3 years of the PharmD Program | |
| University of Rhode Island [2] | College of Pharmacy | BSPS | Standalone | 120 h |
| University of the Sciences in Philadelphia [30] | Science | -BSPS<br>-BS Pharmacology and Toxicology | Standalone<br>Standalone | 132 h<br>128 h |
| University of Toledo [31] | College of Pharmacy and Pharmaceutical Sciences | BSPS (4 majors under the BSPS Degree program)<br>-Medicinal and Biological Chemistry<br>-Pharmaceutics<br>-Pharmacology and Toxicology<br>-Pharmacy Administration | Standalone | 132 h |
| University of Wisconsin–Madison [32] | School of Pharmacy | BS Pharmacology and Toxicology | Standalone | 120 h |
| West Chester University of Pennsylvania [33] | College of Arts and Sciences | Pharmaceutical Product Development | Standalone | 120 h |
| Western Illinois University [34,35] | Department of Chemistry | BS Chemistry with Pharmacy concentration | Standalone | 120 h |

**Table 1.** *Cont.*

| Name of University | Type of School or Department | Name of Program | Standalone or entry level to PharmD program | Number of Credit Hours |
|---|---|---|---|---|
| Wilkes University [36] ^ | College of Science and Engineering | BA in Chemistry with a concentration in Pharmaceutical Science | Standalone | 120 h |
| York College [37] | Arts and Sciences, Chemistry | BSPS | Standalone | 120 h (76–84, plus General education ~) |

*: There is no standalone program for the BSPS: once the student successfully completes the first two years of the professional pharmacy curriculum (P1 and P2), the student will be awarded the BSPS; ^: University of Houston and Wilkes University discontinued their programs in 2013; #: BS/MS: Bachelor of Science/Master of Science; ~: A program of courses in the arts and sciences that students needs to complete successfully before they start taking the classes for their major.

## 2. Methods

The study proposal was approved by the University of Charleston Institutional Review Board. Articles related to BSPS programs for pharmacists were identified via searches of the databases PubMed (provided through the National Library of Medicine and National Institutes of Health (NIH) and International Pharmaceutical Abstracts (IPA) [provided from Ovid Technologies, Inc. (OVID)] OVIDfrom inception to January, 2013. Search terms included: BSPS programs, pharmacy education and dual PharmD/MS. In addition, an Internet search was performed to identify articles in the lay press related to this topic. Searches of the World Wide Web were conducted with the browser Internet Explorer 8.0 and Google Chrome using the advanced search options of Google. The keywords selected for entry into the query box of the browser included the search terms: "BSPS", "Bachelor of Science in Pharmaceutical Sciences" and "degree programs in Pharmaceutical Sciences." Programs at USA colleges and universities were compared regarding the percentage of surveyed programs that include specific pharmacy-related courses within their BSPS curricula.

Next, we conducted a survey to evaluate BSPS program directors' perceptions regarding obtaining the BSPS. Using the American Association of Pharmaceutical Sciences (AAPS) website, 18 universities that offered BSPS degree were identified. A 14-item survey instrument was developed by the authors based on a thorough literature review. (The complete survey instrument is available from the corresponding author upon request). The primary focus of the survey questions pertains to program characteristics and include the types of institutions, curriculum, students' age and the number of students admitted each year. Other parts of the survey pertain to graduates' career directions upon completing the BSPS program. An e-mail invitation with a link to the online survey instrument was sent to all 16 BSPS program directors. The list of e-mail addresses for the directors was obtained from their college's websites. Two BSPS programs were not included in the survey, because they did not have a director for the BSPS program. The BSPS program directors were invited up to 2 times via e-mail. SPSS 16 [38] was used as the software for the analysis.

## 3. Results

Searches of PubMed and IPA yielded 10 documents, and Google searches retrieved 61 websites related to BSPS programs in the USA. Results are summarized in Tables 1–4 and are described in greater detail below.

### *3.1. Findings from the Survey*

Table 1 is a list of 18 schools in the United States that offer the BSPS degree. A survey was sent out to those schools with a response rate of 7/16 (43.7%). A close look at the courses offered by the BSPS programs is presented in Table 2. It is shown that biochemistry is offered in all of the programs (100%), while other frequently offered courses are pharmacokinetics and physiology (85.7%) and notable courses are biopharmaceutics/pharmaceutics, medicinal chemistry and quantitative chemistry, which were also offered (71.4%). On the other hand, courses, such as clinical pharmacy, pharmacy administration and immunology, are least likely to be offered (28.5%).

**Table 2.** BSPS curriculum content.

| What courses do you cover in your program curriculum? | Frequency (Percentage of programs that include the course) |
|---|---|
| Biochemistry | 7 (100.0) |
| Pharmacokinetics | 6 (85.7) |
| Physiology | 6 (85.7) |
| Biopharmaceutics/Pharmaceutics | 5 (71.4) |
| Medicinal Chemistry | 5 (71.4) |
| Quantitative Chemistry | 5 (71.4) |
| Drug Development | 4 (57.1) |
| Biostatistics | 4 (57.1) |
| Microbiology | 4 (57.1) |
| Anatomy | 3 (42.8) |
| Clinical Pharmacy | 2 (28.5) |
| Pharmacy Administration | 2 (28.5) |
| Immunology | 2 (28.5) |
| Other | 2 (28.5) |

A comparison of the characteristics of USA schools and colleges responding to the BSPS survey shows that the majority (71.4%) are public universities and (57.1%) have a pharmacy school, but only (14.2%) of those with a pharmacy school have the BS in Pharmaceutical Science degree as a prerequisite to enter the PharmD program. (Table 3) While only (71.4%) reported that less than 20 students from the BSPS program are admitted to the PharmD program each year, 42.8% reported that student enrollment in the BSPS programs has stayed the same compared to the past five years. Approximately 43% of the schools reported that they have offered the BSPS program for "5–10" years. 85.7% reported the average yearly salary for BSPS graduates going into the workforce upon graduation as between $40,000–$59,999. Two of the schools identified a specialization within their BSPS program.

Although there are jobs after graduation for those students with a BSPS degree, they may choose to pursue a career in pharmacy. Table 4 also shows that the respondents ranked the job placement for the BSPS graduates (from highest to lowest) pharmacy school, postgraduate education and pharmaceutical industry.

**Table 3.** Characteristics of USA institutions who responded to the BSPS survey.

| | **Frequency (%)** |
|---|---|
| **Is your University private or public?** | |
| Private | 2 (28.5) |
| Public | 5 (71.4) |
| **Does your University have a pharmacy school?** | |
| Yes | 4 (57.1) |
| No | 3 (42.8) |
| **If yes, is the BSPS degree a pre-requisite to enter the PharmD program at your University?** | |
| Yes | 1 (14.2) |
| No | 5 (71.4) |
| No Response | 1 (14.2) |
| **How many students are admitted to the program each year?** | |
| Less than 20 | 5 (71.4) |
| 20–39 | 0.0 |
| 40–59 | 0.0 |
| 60–80 | 14.2 |
| More than 80 | 1 (14.2) |
| **What is the average age of the students when they graduate the program?** | |
| 20–25 | 7 (100.0) |
| 26–30 | 0.0 |
| 31–35 | 0.0 |
| Over 35 | 0.0 |
| **How long has the BSPS degree been offered at your school?** | |
| Less than 5 years | 1 (14.2) |
| 5–10 years | 3 (42.8) |
| 11–15 years | 1 (14.2) |
| More than 15 years | 2 (28.5) |
| **Does the program require a capstone project, internship, or anything beyond the didactic courses?** | |
| Yes, capstone | 1 (14.2) |
| Yes, internship | 1 (14.2) |
| Yes, other | 1 (14.2) |
| No | 4 (57.1) |
| **What is the student enrollment trend at your program now compared to the past 5 years and explain why?** | |
| More students apply now | 2 (28.5) |
| Less students apply now | 2 (28.5) |
| Student enrollment has stayed the same | 3 (42.8) |

**Table 3.** *Cont.*

| | Frequency (%) |
|---|---|
| **What do you believe is the average yearly salary of a BSPS graduate who goes straight into the workforce upon graduation?** | |
| Less than $40,000 | 1 (14.2) |
| $40,000–$59,999 | 6 (85.7) |
| $60,000–$79,999 | 0.0 |
| $80,000–$100,000 | 0.0 |
| **Does your program offers any concentration/specializations in the BSPS?** | |
| No | 5 (71.4) |
| Yes | 2 (28.5) |
| **If yes, how many concentrations, specializations, do you offer and what are they?** | |
| One | 0.0 |
| Two | 0.0 |
| Three | 1 (14.2) |
| Four | 1 (14.2) |
| Five | 0.0 |
| No Response | 5 (71.4) |

**Table 4.** Career paths for (BSPS) program graduates.

| **In your estimation, what percentage of students proceeds to each level upon graduating from the program?** | **0–24%** | **25%–49%** | **50%–75%** | **Greater than 75%** |
|---|---|---|---|---|
| Post-graduate Education | 4 | 1 | 1 | 1 |
| Pharmacy School | 1 | 3 | 1 | 2 |
| Pharmaceutical Industry | 5 | 1 | 0 | 0 |

## 4. Discussion

The significance of this investigation is that it is the first study to describe the uniqueness of the BSPS program, including its curriculum, graduation patterns and career paths, and to explore BSPS program director perceptions regarding their programs.

The first goal was to review the literature related to BSPS programs in the United States and to describe the uniqueness of the BSPS program when compared to PharmD and BSPharm programs. Although there are a limited number of schools in the United States that offer a Bachelor of Science in Pharmaceutical Sciences, each school has its own variations in the curriculum they offer. As described previously, BSPS programs focus on preparing students for career opportunities that differ from the PharmD. This degree is also used as a stepping stone for multiple professional programs, including pharmacy, dentistry, medicine and law [19,31].

### *4.1. Findings from the Literature Review*

It is important to note that the core components for the former five-year BSPharm are very comparable to the current pre-pharmacy curriculum for the PharmD degree, as well as the pre-professional division of the BSPS degree. The former five-year BSPharm degree required two years of pre-pharmacy

coursework similar to the current requirements for the PharmD and the BSPS programs. According to the University of Toledo website, once admitted to the BSPS program and after completing the two-year pre-professional coursework, there will be an additional two years of professional coursework. These two years will consist of the following courses: Medicinal Chemistry I and II, Physical Chemistry I and II, Pharmacology I, II and III, Microbiology and Immunology, Pharmaceutics I and II, Chemotherapy and Immunotherapy, Biopharmaceutics and Pharmacokinetics, Professional Practice Development I and II, Human Interaction in Healthcare, Drug Therapy I and II, Healthcare Administration and internship [31]. This particular program differs from the other BSPS programs, as there may be an option to select a specialized track within the BSPS program [31].

The first two professional years of curriculum in the BSPS program are very similar to the first two professional years of the BSPharm program. The third and fourth professional years in the BSPS program focus the curriculum on the track chosen by the student. For example, if the medicinal and biological track is chosen, the student's fourth professional year would be focused on targeted drug design, advances in drug design, medicinal biotechnology lab, new drug development and biochemistry of disease. However, in the BSPharm program, fourth and fifth year students' curriculum focused more on therapeutic and pharmacology classes [31].

### *4.2. Curriculum Comparisons among BSPS Program*

Like other Bachelor of Science degree programs, the BSPS is a four-year undergraduate degree, but instead of focusing only on biology and/or chemistry, these programs have an emphasis on pharmaceutical sciences. For most BSPS degree programs, the first two years of studies focus on basic sciences and liberal arts, including general chemistry, organic chemistry, calculus and English composition. The third and fourth year classes describe each program's unique characteristics. Close to one-half of the BSPS programs are not offered by a school or college of pharmacy. However, the majority that offer the BSPS programs are affiliated with their respective pharmacy schools. The University of California at Irvine, York College and Cleveland State University are examples of standalone programs that are not affiliated with a school of pharmacy [11,22,37].

The University of Toledo has four tracks within its BSPS program, including Medicinal and Biological Chemistry (MBC), Pharmaceutics (PHAR), Pharmacology/Toxicology (PTOX) and Pharmacy Administration (PHAM). The third and fourth year curriculum will vary depending on which track the student chooses to take [31]. The University of Michigan also has four majors within their BSPS degree: Pharmaceutics, Pharmacognosy, Pharmaceutical Analytical Chemistry and Pharmacology [27]. Purdue University has two options for its students to engage in research, the first with the Department of Medicinal Chemistry and Molecular Pharmacology (MCMP) and the second with the Department of Industrial and Physical Pharmacy (IPPH) [19]. Moreover, Cleveland State University has three tracks within the BSPS program: Pharmaceutical Chemistry and Analysis; Medicinal and Biological Chemistry; and Pharmacy Administration.

The remaining schools reviewed for their BSPS degree included Ohio State University, University at Buffalo, Campbell University, Massachusetts College of Pharmacy and Health Sciences, Albany College of Pharmacy and Health Sciences, University of the Sciences in Philadelphia, University of California at Irvine, South Dakota State University, York College, University of Rhode Island,

University of North Carolina, Chapel Hill, , University of Houston, University of Delaware, Elizabeth City State University, University of Georgia, University of Connecticut and The University of Mississippi. These have only one track for all students. Students' classes may vary depending on electives chosen. One unique quality about the University of Mississippi is that it requires the completion of the BSPS program as a prerequisite for entry into their PharmD program [28]. Some universities, such as the University of Mississippi, award a bachelor of science in pharmaceutical sciences (BSPS) degree as a part of the seven-year PharmD program after the completion of the first four years [28]. However, this does not mean that all students in the BSPS program are interested in being admitted into the school of pharmacy [4]. South Dakota State University and the University of North Carolina, Chapel Hill, offer a BSPS degree, but only in conjunction with the PharmD program. The BSPS provides a solid foundation in pharmaceutical sciences, which then leads into the PharmD degree (See Table 1) [20,29].

The University of Michigan, Albany College of Pharmacy and Health Sciences and the University at Buffalo all offer combined programs, which allow students to receive the BSPS, along with a master's degree [1,9,38]. The joint program at the University of Michigan is the BSPS with a Master's in Pharmaceutical Engineering, which can be completed in five years [39]. The University at Buffalo allows students to graduate in less than six years with a dual Bachelor of Science/Master of Science in pharmaceutical sciences [1].

Wilkes University, West Chester University of Pennsylvania, Michigan Technological University, Pittsburg State University, Fairleigh Dickinson University, University of Wisconsin Madison, University of California, Davis, and Western Illinois University all offer a BS in Chemistry with a concentration in Pharmacy or a BS in Pharmaceutical Chemistry [13,17,18,32–36,40]. Moreover, Fairleigh Dickinson University offers a BS in Mathematics with a Pharmaceutical Biostatistics Concentration [35].

### *4.3. Job Opportunities for BSPS*

Graduates with pharmaceutical science degrees are employed for entry-level positions in the pharmaceutical and cosmetics industries, government and specialty laboratories and biotechnology companies. Specific positions exist in product development, research, production/manufacturing, quality control/quality assurance, technical services, regulatory affairs and packaging of products. Most pharmaceutical industries employ graduates with pharmaceutical science degrees with knowledge in drug design, pharmacogenomics, drug information and biotechnology, among others [5]. Most schools offering the BSPS program have ties within the major pharmaceutical industries. For instance, the BSPS program at Massachusetts College of Pharmacy and Health Science University works closely with the New England biotechnology and pharmaceutical companies [15]. Another area also in high demand for BSPS graduates is regulatory agencies, such as the Food and Drug Administration (FDA). Job opportunities at the FDA include drug evaluation and research, pharmaceutical compliance in good manufacturing practices (GMP), research on new drug safety and clinical trials [41]. This somewhat corroborates the survey results from Table 4, which gauges the perceptions of program directors for the progression of students beyond the BSPS program.

Graduates with a BSPharm degree work in community pharmacies, hospitals and the pharmaceutical industry. When comparing specific practice settings for graduates of the BSPharm, 90% practice in

community pharmacies and hospital practice, while only 4.2% work in the pharmaceutical industry [42]. On the other hand, BSPS graduates work primarily in the pharmaceutical industry. Alumni from the BSPS program at the University at Buffalo completed a survey, which revealed that approximately 90% of students pursue and are employed in the pharmaceutical industry, while 10% pursue graduate studies [1].

### *4.4. Job Satisfaction among BSPharm, PharmD and BSPS Practitioners*

During the early implementation from the BSPharm to PharmD, most BS pharmacists were more likely to practice at community pharmacies, while PharmDs were practicing in teaching, research and management positions. PharmD graduates spend less time in a dispensing role than BSPharm pharmacists [42]. In 2006, a drug topics online survey was conducted with respondents from BSPharm, PharmD and non-traditional PharmD programs. In community practice, most of the reporting pharmacists believed that the BSPharm degree was sufficient to fulfill the job description and demands [43]. Regarding the mandatory movement from BSPharm to PharmD, the online results of the survey showed that 88% thought the BSPharm was sufficient for dispensing roles in a pharmacy [43]. In continuation, there have also been reports about more job satisfaction, especially with people who went back for their non-traditional PharmD. These pharmacists were able to acquire higher level positions, to receive more clinical roles, to add to the prestige of being called doctor and had a higher salary [42]. Of the BSPharm pharmacists who made the commitment to earn a non-traditional PharmD, 92% said "the tassel was worth the hassle" [42]. In regards to the community pharmacy, as the proportion of BSPharm pharmacists continues to decline, it will be interesting to see how the trends with job satisfaction will change among PharmDs in community pharmacy practice [42]. Currently, pharmacists may also work in hospitals, with disease management, consulting, academia, long-term care, pharmaceutical industry, mail service, managed care and government, each with varying requirements for pharmaceutical care skills [44,45].

While there is ample information available on job satisfaction with graduates with BSPharm and PharmD, no such studies were identified for the graduates with BSPS. The information available so far is from schools and employers as tools to increase interest in the degree and career field. Further research is needed to determine job satisfaction among BSPS graduates.

### *4.5. Salary and Compensation*

Although the demand for pharmacists with BSPharm or PharmD has moderated in recent years, it is still a field that commands a high income. According to the Bureau of Labor Statistics, the median annual salary for pharmacists in May, 2010, was $111,570 [46]. They also project a 25% increase in pharmacy employment between 2010 and 2020 [46]. Graduates from BSPS programs are equally in high demand. The minimum commitment of six years to receive a PharmD, the limited number of BSPS programs available and the explosion in the field of biotechnology and pharmacogenomics has significantly paved the way for the demand of graduates with degrees in pharmaceutical sciences [4]. According to the Bureau of Labor Statistics, the median annual wages of wage and salary for drug manufacturing and sales in May, 2010, was $56,620 [47]. The Bureau of Labor Statistics also ranks pharmaceutical manufacturing amongst one of the fastest growing industries. A 16% increase in job outlook for drug manufacturing and sales is expected from 2010 to 2020 [47]. On the other hand, according to a 2011 survey conducted by AAPS , the average annual salary for BSPS graduates in the

pharmaceutical industry was $99,200, while the average starting salary for individuals beginning their career in 2011 was $84,500 [48].

The second goal of this study was to identify the perceptions of BSPS program directors. Our findings suggest that individuals with a BSPS degree are more likely to pursue further education by entering into a PharmD program or other post-graduate education. In correlation with this finding, respondents to our survey believe that having a BSPS degree better prepared students for the PharmD program than those with another basic science degree. When looking at the curriculum of each individual program, we also found that courses, such as biochemistry, biopharmaceutics/pharmaceutics, pharmacokinetics, medicinal chemistry and quantitative chemistry, are more likely to be incorporated, due to the fact that a BSPS degree often focuses on preparing graduates to work in the pharmaceutical industry. Although, the evidence of our finding shows that a large portion proceed into pharmacy, the article by Broedel-Zaugg *et al*. indicates that there is a demand for qualified personnel with a BSPS degree in the pharmaceutical industry for drug development [4]. We cannot comment on the qualification of a BSPS degree in preparing graduates to work in the pharmaceutical industry, nor can we draw a conclusion on how many will pursue that route. There has not been a study like ours, and we hope our findings will suggest further research regarding standardization of BSPS curricula and expanded roles for such graduates. We also support a dialogue concerning whether permitting BSPS graduates in future standardized programs to perform basic dispensing skills in community and hospital settings might potentially redistribute the pharmacy workforce in a manner that cost-effectively enhances patient access to pharmaceutical care services, much as physician assistants and nurse practitioners have extended physician resources.

This study has at least one limitation. As it was a self-administered email survey, there is the potential for non-response bias. Repeated contacts were used to try to limit non-response bias. The relatively low response rate of around 44 percent is a limitation of the study in that those who responded may be systematically different than those who did not respond on variables of interest. Despite this limitation, we maintain that these results can provide useful insight into the availability, uniqueness and perceived value of the BSPS programs in the United States.

## 5. Conclusion

In conclusion, the BSPS is a versatile degree that prepares students to pursue a Master's, PhD and even a PharmD. Graduates with this degree generally will work directly or indirectly within the pharmaceutical industry. Their field of work is determined by their educational background and career interests. The BSPS, the former BSPharm and PharmD all have some similar courses required for graduation or as pre-professional requirements. All degrees listed above allow students to have a solid science foundation. All the BSPS programs assessed are affiliated with USA universities. The BSPS will not qualify a graduate to work as a licensed pharmacist, but serves as the most relative degree that prepares students to receive a PharmD and/or work in the pharmaceutical industry. Currently, the BSPS programs have yet to receive a large amount of attention, but the importance in pharmaceutical education cannot be denied.

## Conflicts of Interest

The authors declare no conflict of interest.

## Acknowledgment

We sincerely thank the following individuals for their contributions to the literature review reported in this paper: Gagan Kaushal and John Bowman.

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