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# A Bibliometric Analysis of Pharmaceutical Sciences-Related Articles in Qatar from 2013-2020

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Authors MIMI and SI did conceptualization and methodology. Authors SI, MIMI, FA and NB performed formal analysis and investigation. Authors SI, MIMI, FA and NB wrote the original draft, reviewed and edited the manuscript. Author MIMI did funding acquisition and supervision. Authors SI, MIMI, FA and NB did literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

**Background:** Pharmaceutical science is an important area in drug discovery and therapies.The research output generated from pharmaceutical sciences research is critical for psychological, physical, and social wellbeing. This study was carried out to analyze Qatar's quantity and quality of pharmaceutical sciences-related research and map out a national research roadmap and priority areas.
**Materials and Methods:** A systematic search was carried out in the Web of Science, Scopus, Pub Med, and Google Scholar databases using the search terms "Pharmaceutical Science," "Pharmaceutical Chemistry," "Medicinal Chemistry," "Pharmacology," "Pharmaceutics,"

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"Pharmacokinetics," "Physiology," "Pharmaceutical Science research," "Study," other relevant terms related to Pharmaceutical Sciences field and "Qatar." The search covered eight years. The data extracted included the title, keywords, publication date, authors, publishing journal, journal ranking, impact factor, type of article, number of citations, the sum of citations, H-index, etc.

**Results:** The search yielded 123 studies. Most were original articles (n=100, 81.3%), published in 2019 (n=27, 22.0%), applied research (n=68, 55.3%),indexed in Web of Science (n=120, 97.6%), published under the subject of pharmacology (n=43, 42.6%), focused on cancer (n=46, 37.4%) and produced by five authors (n=19, 18.8%) and more than eight authors (n=19, 18.8%). Hamad Medical Corporation (HMC) was the main collaborator (n=16, 13.0%). Fifty-four (43.9%) of the articles were published in journals ranked as Q1.

**Conclusions:** A total of 123 articles were published, with an average annual growth rate of 6.7% in publications and 946 citations. A high number of publications were in Q1 and Q2 journals. The research focus (e.g., cancer and cardiovascular) was established according to the country's research roadmap and priority areas.

*Keywords: Bibliometric analysis; journal metrics; pharmaceutical sciences; research publications; Qatar.*

## 1. INTRODUCTION

### 1.1 Background

Pharmaceutical science is an interdisciplinary field and a dynamic area [1]. It is important for the discovery and development of new medicines and treatments [2]. Pharmaceutical sciences aim to integrate fundamental principles of physical and organic chemistry, biochemistry, biology, and engineering to understand how to optimize drugs' delivery to the body and translate this integrated understanding into new and improved therapies against disease.

Pharmaceutical science is an important area of study and research. In recent decades, many publications have been generated from studies conducted at Qatar University (QU), the country's major institution of higher education, which was founded in 1977.Qatar University College of Pharmacy (CPH) is the only college of pharmacy in the country [3]. Planning for this college began in 2006, and the first batch of students was enrolled in September 2007.The college has two departments, Pharmaceutical Sciences, and Clinical Pharmacy and Practice, with 32 academic staff and 15 administrative and technical staff.

In the recent past, the country has been concerned with research, quality of research, the impact of research, and return on investment (ROI) from grants provided for researchers. In Qatar, Qatar University and the Qatar National Research Fund, for example, have produced research roadmaps as part of strategic planning for research and development, with research priority areas including cancer, cardiovascular disease, diabetes mellitus, etc. These agencies then opened opportunities for researchers to apply forgrants for the respective research areas. Money is one of the scarce resources, and research grants are becoming more competitive. Thus, researchers must focus on the research areas beneficial to the nation and provide high returns (i.e., ROI). Pharmaceutical sciences research (e.g., medicinal/pharmaceutical chemistry, pharmacology, pharmaceutics, pharmacokinetics) has an impact on the health and pharmacy sectors and on each pharmacy practitioner in healthcare settings academician in colleges.

The terms quality research and quality evidence are related concepts that have been at the center of much debate in academic, professional, and public policy circles [4]. To some extent, the debates stem from the widespread belief that the quality of scientific research is often uneven and lacking in credibility, making it difficult to make a confident, concrete assertion or prediction regarding evidence for improving practice or patient health outcomes. This study explores the nature of pharmaceutical sciences research, the insights it provides, its impact, and the challenges faced in terms of its capacity and sustainability. The research is expected to (i) strengthen the services provided; (ii) build the evidence base for developing and commissioning new services; (iii) improve patient care; (iv) contribute to the knowledge base within health service research more widely; and (v) produce professional and personal gains in the processas it helps in identifying the research trend and focus areas. To what extent has

pharmaceutical sciences-related research been conducted in Qatar to date? Are the studies of good quality? Do the studies involve international collaboration? The information generated from this study can be used to measure the quality of research, describe the impact, and enhance visibility. Bibliometric methods are used to measure scientific publications and describe their authors [5,6].

### 1.2 Research Questions and Objectives

This study was interested in answering the following research questions: (1)What are the quantity and quality of pharmaceutical sciences-related studies produced?; and (2) according to the national research roadmap planned, are pharmaceutical sciences-related studies conducted in the country? The study was carried out to respond to the research questions and fulfill the following research objectives:

1. Analyze the quantity and quality of pharmaceutical sciences-related research in Qatar;
2. Map out the pharmaceutical sciences-related research areas with national research roadmaps and priority areas; and
3. Set and shape future research directions for pharmacy academicians and practitioners in the country.

## 2. MATERIALS AND METHODS

### 2.1 Study Design

According to the OECD, bibliometric research is defined as:

"The statistical analysis of books, articles, or other publications... to measure the 'output' of individuals/research teams, institutions, and countries, to identify national and international networks, and to map the development of new (multi-disciplinary) fields of science and technology" [7]. Bibliometric analysis is a useful tool to obtain information about the current state of research in particular areas and allows researchers to identify and undertake new research lines [8,9]. This study provides information regarding the quantity and quality of research in pharmaceutical sciences research in the country. It follows the current national research roadmap and can contribute to setting up and shaping future research directions for academicians and practitioners in the country. The rigor and accuracy of this study depend primarily on the bibliographic search that was carried out. As mentioned above, the primary aim is to analyze scientific productivity in pharmaceutical sciences research in Qatar.

### 2.2 Search Strategy

A systematic search was carried out in several databases including the Web of Science, Scopus, Pub Med and Google Scholar using the search terms "Pharmaceutical Science", "Pharmaceutical Chemistry", "Medicinal Chemistry", "Pharmacology", "Pharmaceutics", "Pharmacokinetics", "Physiology", "Pharmaceutical Science research", "Study", other relevant terms and "Qatar". The other relevant terms included describing and covering all fields related to pharmaceutical sciences disciplines using MeSH terms in Pub Med combined with "Qatar".

For example, source – (i) Web of Science (WoS): It provides comprehensive citation data and an analytical information platform. It includes over 21,000 peer-reviewed, high-quality scholarly journals published worldwide (including open access journals), over 205,000 conference proceedings, and over 104,000 editorially selected books [6].

(ii) Google Scholar's citation can trace citations originating from various scholarly sources, such as journals, conference papers, books, book chapters, web-based full-text articles, reports, e-theses, and dissertations, rather than less scholarly sources, such as web CVs, web pages and webliographies.
The systematic search was performed in the English and Arabic languages. The search covered the period from January 2013 to 31 December 2020 using the different search engines. In this period, the number of publications affiliated with QU started to increase noticeably.

### 2.3 Inclusion and Exclusion Criteria

Different article types, such as original research articles, case reports, review articles, short communications, letters to the editor, brief reports, case series, and education forums, were included in this study. Other considerations were the language of the articles and the publication dates. Drug bulletins, articles not published in online journals, online pharmacy newsletters, conference presentations, etc., were excluded. Other considerations were articles published not

in English or Arabic language and whether they were published outside the indicated period.

### 2.4 Data Collection, Validation and Analysis

Based on the inclusion and exclusion criteria, two authors independently extracted data from all included publications, including the title, keyword, publication date, authors, publishing journal, journal ranking, the impact factor (IF), type of article, number of citations, the sum of citations, H-index, etc. The data and information that were obtained from the different databases were inputted into MS-Excel 2010 and SPSS version 26 (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp) and analyzed. All the information were again checked and screened.

Descriptive analyses of key descriptive study variables were conducted and summarized in the tables and figures based on the study's objectives. The following indicators/outcome measures were used in the analysis: (i) IF analysis of the journal in which the article was published; (ii) other quality measures of the journal in which the article was published; (iii) bibliometric indices - h, g, hg and q2; (iv) type of article: original article, review, etc.; (v) citation analysis – to determine the establishment of relationships between authors and their work – performance analysis (number of authors who contributed, authors' affiliation – institutions; degree of collaboration – research networks, most productive authors, and the total number of publications).

## 3. RESULTS

### 3.1 Type of Publication

In Table 1, the documents' distribution in the pharmaceutical science literature is presented. It is clear that out of 123 research articles, 81.3% (n=100) were research articles, followed by reviews (n=22, 17.9%) and letters (n=1, 0.8%). Compared to other types, research articles had the highest ranking. Journal articles varied between applied (n=68, 55.3%) and basic (n=32, 26.0%) articles (Table 2). In Table 3, articles indexed in Scopus and Web of Science are illustrated. A total of 97.6% (n=120) of articles were indexed in Web of Science, while 88.6% (n=109) of articles were indexed in Scopus.

### 3.2 Ranking of Publications per Discipline

The distribution of articles per discipline is illustrated (Fig. 1). A total of 37.4% (n=46) of the articles were published in the subject area of pharmacology, followed by pharmaceutical technology (n=43, 35.0%), medicinal chemistry (n=14, 11.4%), physiology (n= 10, 8.1%) and toxicology (n= 10, 8.1%).

**Table 1. Type of documents published**

| Type of document | Frequency | (%) |
|---|---|---|
| Research article | 100 | 81.3 |
| Review | 22 | 17.9 |
| Letter to editor | 1 | 0.8 |
| **Total** | **123** | **100** |

**Table 2. Type of work published**

| Type of work | Frequency | (%) |
|---|---|---|
| Applied | 68 | 55.3 |
| Basic | 32 | 26.0 |
| Not applicable | 23 | 18.7 |
| **Total** | **123** | **100** |

**Table 3. Articles indexing percentage**

| Indexing | Yes | No | Total (%) |
|---|---|---|---|
| Scopus | 88.6 | 11.4 | 100 |
| Web of Science | 97.6 | 2.4 | 100 |

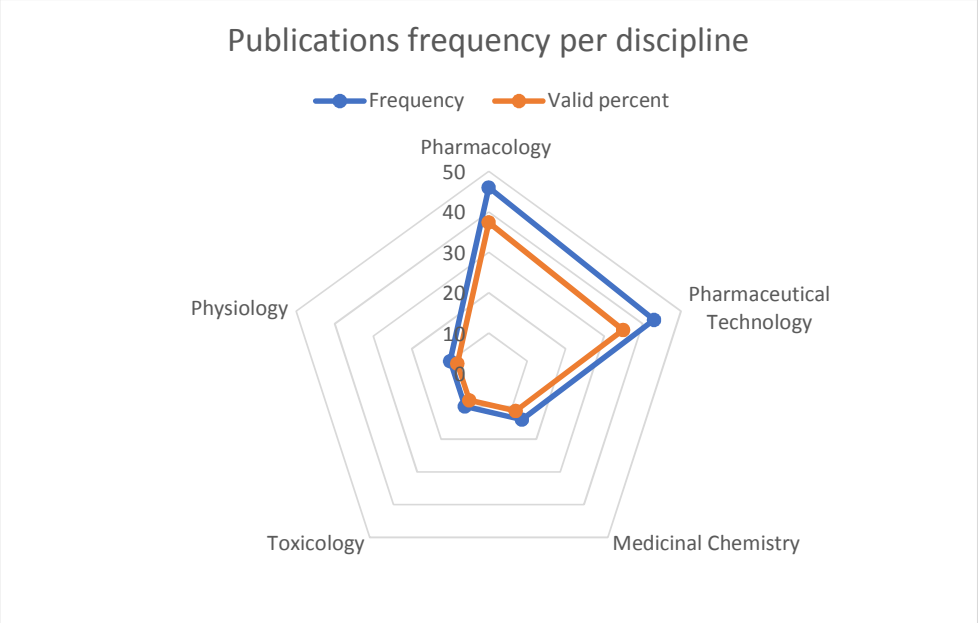


**Fig. 1. Publications frequency per discipline**

### 3.3 Distribution of Publications and Citations

During 2013–2020, the number of pharmaceutical science research publications increased (Table 4). The highest number of articles was published in 2019, with 27 articles (22.0%), followed by 2020, with 26 articles (21.1%). Concerning the number of publications, these two years are considered the most fruitful years. In contrast, 2013 and 2014 are considered the least productive years, with 4 (3.3%) and 6 (4.9%) publications per year. In 2015, the highest citations (n=216) were achieved, followed by 2017 (n=172). In contrast, 2013 and 2014 achieved the lowest citations (n=34 and n=48, respectively).

### 3.4 Research Collaboration

Many collaborations took place among authors and colleges, offices and institutions in Qatar (Fig 2). Hamad Medical Corporation (HMC) is considered the main collaborator in 16 articles published by the Department of Pharmaceutical Sciences in CPH, followed by the College of Medicine (n=14) and Biomedical Research Center (BRC) (n=12) from QU.

**Table 4. Number of publication and citation per year**

| Publication year | Number of publications | % of 123 | Citations |
|---|---|---|---|
| 2020 | 26 | 21.1 | 9 |
| 2019 | 27 | 22.0 | 106 |
| 2018 | 21 | 17.1 | 171 |
| 2017 | 14 | 11.4 | 190 |
| 2016 | 8 | 6.5 | 172 |
| 2015 | 17 | 13.8 | 216 |
| 2014 | 6 | 4.9 | 48 |
| 2013 | 4 | 3.3 | 34 |
| **Total** | **123** | **100** | **946** |

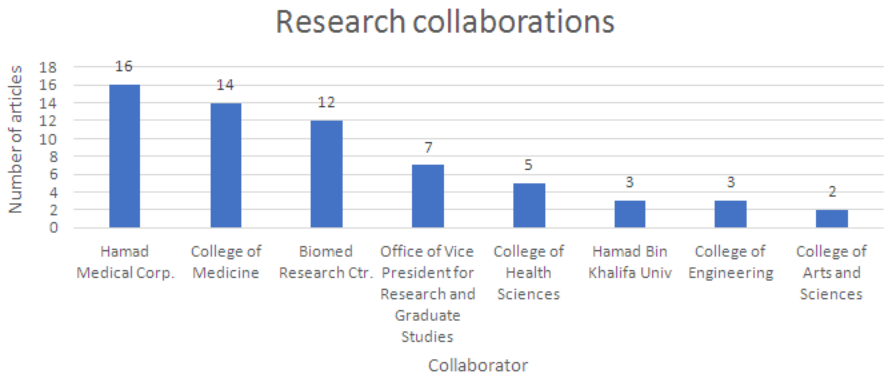


**Fig. 2. Research collaborations with CPH in QU**

### 3.5 Disease-focused Research

The distribution of published papers per disease is illustrated in Fig 3. The majority of papers focused on studying cancer and cardiovascular diseases. Cancer was ranked first, with 43 (35.0%) articles, followed by cardiovascular diseases, with 27 (22.0%) articles. Lung diseases had a total of 4 (3.3%) published articles.

### 3.6 Journal Quality Metrics and Frequency of Publication

Papers affiliated with the pharmaceutical sciences department were published in several journals. From Table 5, the International Journal of Pharmaceutics was ranked as the first journal, publishing 8 (7.9%) articles affiliated with CPH at Qatar University, followed by the journal of Oxidative Medicine and Cellular Longevity, in which 5 (5.0%) articles were published. In contrast, Bio Med Research International, AAPS Pharm Sci Tech, Plos One, and Toxicology letters ranked in fourth place, with only 3 (3.0%) articles published in each journal. Articles affiliated with CPH in QU are published in journals in various quartiles. From Fig 4, journals belonging to Q1 are ranked the highest by 43.9% (n=54) of total journals, followed by 41.5%(n=51) of journals that belong to Q1. In contrast, only 4.5% (n=6) of journals belong to Q4.The IF of the journals ranged from 0.230 to 11.090 (median (IQR) = 3.380 (2.393-4.684)).The median (IQR) of the journal H-index was 97.00 (54.25– 149.00; range: 17 to 300).The median average (IQR) of the cite score was 5.00 (3.70 – 6.55; range: 1 to 15).

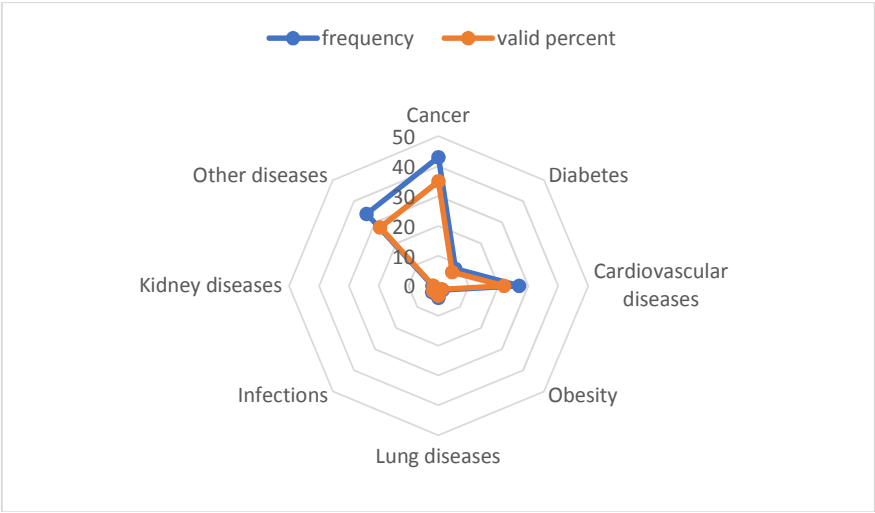


**Fig 3. Disease focused research**

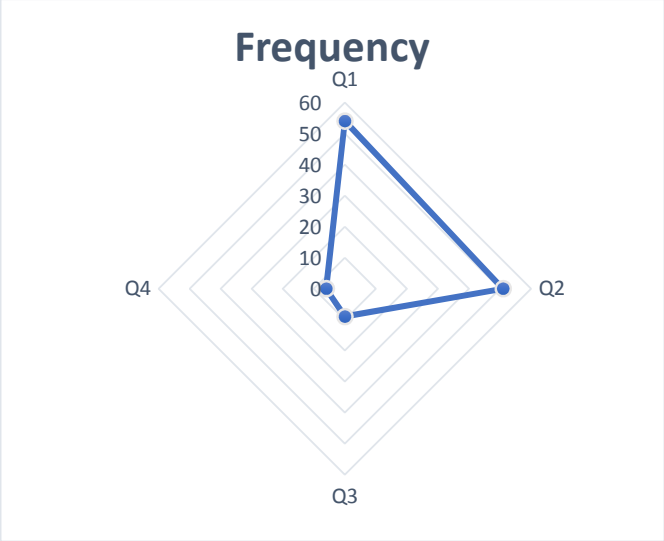


**Fig. 4. Scientific journal rankings - quartiles**

**Table 5. Journals ranking**

| Journal name | Records | % of 123 | Rank |
|---|---|---|---|
| International Journal of Pharmaceutics | 8 | 7.9 | 1 |
| Oxidative Medicine and Cellular Longevity | 5 | 5.0 | 2 |
| Biomolecules | 6 | 4.0 | 3 |
| Journal of Cellular Physiology | 4 | 4.0 | 3 |
| Pharmaceutical Development and Technology | 4 | 4.0 | 3 |
| Archives of Toxicology | 4 | 4.0 | 3 |
| Natural Product Communications | 4 | 4.0 | 3 |
| BioMed Research International | 3 | 3.0 | 4 |
| AAPS Pharm SciTech | 3 | 3.0 | 4 |
| Plos One | 3 | 3.0 | 4 |
| Toxicology letters | 3 | 3.0 | 4 |

### 3.7 Corresponding Author Distribution in Publications

The ranking list of corresponding authors (senior authors) is very useful in determining the popularity and contribution of authors to the college or department with which they are affiliated. Referring to Table 6, the corresponding author FM was ranked first, with 13 (10.6%) articles. The corresponding authors, AE and AG were ranked second, with 12 (9.8%) articles for each corresponding author, followed by AK, with 10 (8.1%) articles in pharmaceutical sciences.

**Table 6. Corresponding author wise distribution of publications**

| Corresponding authors | Records | % of 123 | Corresponding author ranking |
|---|---|---|---|
| Fatima Mraiche | 13 | 10.6 | 1 |
| Abdelbary Elhissi | 12 | 9.8 | 2 |
| Abdelali Agouni | 12 | 9.8 | 2 |
| Ashraf Khalil | 10 | 8.1 | 3 |
| Feras Alali | 9 | 7.3 | 4 |
| Ayman El-Kadi | 8 | 6.5 | 5 |
| Hesham Korashy | 6 | 4.9 | 6 |

**Table 7. Authorship pattern in all publications from 2013-2020**

| Authorship pattern | No of articles written by authors | % of 123 |
|---|---|---|
| Single Author | 1 | 0.8 |
| Two Authors | 8 | 6.5 |
| Three Authors | 12 | 9.8 |
| Four Authors | 14 | 11.4 |
| Five Authors | 19 | 15.4 |
| Six Authors | 15 | 12.2 |
| Seven Authors | 11 | 8.9 |
| Eight Authors | 17 | 13.8 |
| More than Eight Authors | 19 | 15.4 |
| Total articles | 123 | 100 |

In Table 7, the authorship pattern is described. Five authors produced most articles (n=19; 18.8%) and more than eight authors, respectively, as collaborative work, followed by articles written by eight authors (n=17, 13.8%).

## 4. DISCUSSION

A bibliometric analysis was conducted for journal literature on pharmaceutical sciences research published in Qatar and affiliated with the Pharmaceutical Sciences Department at CPH during 2013-2020. The required data were retrieved from the Web of Science, Scopus, PubMed, and Google Scholar databases. A total of 123 papers and a letter to the editor were collected, with an average annual growth rate in the publication of 6.7%. There were mostly original articles (n=100, 81.3%), 2019 (n=27, 22.0%), applied research (n=68, 55.3%), indexed in Web of Science (n=120, 97.6%), published under the subject of pharmacology (n=43, 42.6%), focused on cancer (n=46, 37.4%) and produced by five authors (n=19, 18.8%) and more than eight authors (n=19, 18.8%). Hamad Medical Corporation (HMC) was the main collaborator. Fifty-four (43.9%) of the articles were published in scientific journals ranking in Q1.

Pharmaceutical sciences research provides benefits to patients and society through innovations in drug therapies. Universities, colleges, and governments have an enormous challenge in meeting the societal demand for drug therapies that save lives. The benefits to public health and well-being outweigh the costs for new or improved medications. The benefits to patients are found in the research. However, what is the quality of the publications generated from the research funding provided to the researchers? Scientific publishing can be evaluated quantitatively and qualitatively. The qualitative evaluation involves a peer review process and successful publishing in journals. Quantitative evaluation can be performed through bibliometric methods. Indicators are used to illustrate the productivity, impact, and quality of the published articles.

The College of Pharmacy is the only college in the country that produces pharmacy graduates. It is the primary setting that produces research in pharmaceutical sciences, such as pharmaceutical chemistry, medicinal chemistry, pharmacology, and pharmaceutics. The research output from the College of Pharmacy and other colleges is critical in ensuring the world ranking of Qatar University [10]. According to the Times Higher Education (THE) World University Rankings 2021, QU has jumped up to the 301-350 band [11]. One of the performance indicators is research and its output.

There is a general sense that universities are failing to meet the needs of society and the marketplace [12].The CPH can compete effectively and fulfill the needs of the different stakeholders to focus on research that both influences knowledge development (i.e., basic research) and is problem-driven (i.e., applied research). Our studies indicated that slightly more than three-fourths of pharmaceutical sciences research was applied and basic research. The two major focus areas of the College of Pharmacy were cancer, followed by cardiovascular disease. In accordance with the Qatar National Development Strategy (2018-2022; NDS-2), the focus should be on treatment and proactive prevention [13]. Thus, research in pharmaceutical sciences should emphasize applied and basic research. Notably, 69% of mortalities in Qatar are attributed to three main categories of disease, namely, cardiovascular diseases (24%), diabetes (7%), and cancer (18%).Thus, under the biomedical & health pillar,

QU has prioritized the following research areas: (1) diabetes and cardiovascular diseases; (2) cancer; (3) neurological and psychiatric disorders and mental health; (4) respiratory diseases; and (5) infectious diseases. For the Qatar National Priorities Research Program under Qatar National Research Funding, the same pillar's focus areas were cancer, cardiovascular, diabetes, mental & neurological, renal and reproductive, maternal & child health [14]. Pharmaceutical science researchers from the College of Pharmacy should conduct more research in the university and country's priority areas.

Approximately two-thirds of the research in pharmaceutical sciences was focused on the pharmacology and pharmaceutics disciplines. Both are significant to the research priority areas of the country. Both can be carried out in either basic or applied research, depending on the research question. The major contribution of pharmacological research has been the advancement of knowledge on the cellular receptors with which drugs interact. Its contribution to cancer and cardiovascular research, for example, is significant. Moreover, with the increasing complexities of drug entities (e.g., monoclonal antibodies) and formulations (e.g., nanotechnology) and the challenges in dealing with complex patients and complex health conditions, the area of pharmaceutics or pharmaceutical technology is becoming very important [15]. Researchers in the area of pharmaceutics must address these new challenges and have the ability and knowledge in personalized medicine. The combination of the various pharmaceutical science areas will surely provide solutions in therapies for and the prevention of chronic illnesses, in particular.

According to MacIntosh et al. [16], one of the contemporary discussions about academic research is its relevance and impact [16] in academia and society [17]. Besides, quality academic research should be supported by scientific and methodological thoroughness and accuracy. Quality research will then be accepted and published in quality journals. An important factor in the quality assurance of pharmaceutical science research is the publication process. Quality journals offer peer-review and blinded processes to ensure the best quality control. Further, scientometrics (i.e., a subfield of bibliometrics), such as IF and citation index, is used to analyze the quality of the publications quantitatively. However, scientometrics alone will not provide the full picture of a scientific journal. As mentioned above, the IF of the journals used by pharmaceutical science researchers ranged from 0.230 to 11.090.The range of the journals' H-index was between 17 and 300, while the citation score range was between 1.00 and 15.00.The research output was published in reasonably high-quality journals. Whether it is considered of low/high and poor/good quality, the IF of a scholarly journal varies depending on the specialization and discipline of the journal. However, Eder and Frings [18] argued that it is well documented that the IF is influenced by many factors that are unrelated to the scientific quality of journal articles [18].

The three journals (out of 78 different journals used) that were most commonly targeted by pharmaceutical sciences researchers were the International Journal of Pharmaceutics (IF=4.845), Oxidative Medicine, and Cellular Longevity (IF=5.076) and Biomolecules (IF=4.082). All have an IF greater than 1.0 and ranked in Q1 and Q2. Eder and Frings [18] mentioned a few standards that researchers can use to judge the quality of publications:(1) a good journal has a specialty; (2) a good journal has rigorous peer review; (3) a good journal is transparent; (4) a good journal honors the value of reproducible data; and (5) a good journal is author-friendly (18).The top journals in which the work was published are of good quality.

## 5. STRENGTHS AND LIMITATIONS

For the first time, this study provided a clear picture of the publication trend and pattern in the Pharmaceutical Sciences discipline in QU. In addition, it provided an overview of the number of publications affiliated with QU yearly. This study focused on quantitative aspects of research output. The research output's qualitative aspects, such as funding received, patents obtained, and awards granted, were not measured. Both aspects assess the quality and impact of research. Furthermore, high citation counts may not indicate quality. Some research areas tend to cite papers more often than other disciplines. Another point worth mentioning is that the sources used to gather publication data may index different journals.

## 6. RECOMMENDATIONS

Researchers in pharmaceutical sciences disciplines, particularly at the CPH, should focus on obtaining more funding for their research in

niche areas. A greater number of funding agencies should come forward and provide financial assistance to the researchers. In this study, it is depicted that the researchers' strengths are in cancer and cardiovascular research. The study also indicated that the research impact of the researchers was very satisfactory. If aid comes from the government, university, and pharmaceutical companies, this pharmaceutical science research area will develop quickly. This research is critical to improving the wellbeing of society. Researchers are also encouraged to collaborate with more international agencies, which have advanced knowledge and technology.

## 7. CONCLUSION

In this paper, 123 articles were published, with an average annual growth rate of 6.7% in publications and 946 citations. Many publications were classified under Q1 and Q2 journals, which reflects that the top journals in which the work was published are of good quality. The research focus followed the country's research roadmap and priority areas (e.g., cancer and cardiovascular). Thus, publications affiliated with the area of pharmaceutics must address these new challenges. It has the ability and knowledge in personalized medicine, which helps provide solutions in therapies for and prevent chronic illnesses.

## AVAILABILITY OF DATA AND MATERIALS

Data is available from the senior author upon request.

## CONSENT

Not applicable.

## ETHICAL APPROVAL

Not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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