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Pharmaceutical Scientists' Perspectives on Capacity Building in Pharmaceutical Sciences

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ABSTRACT

With the anticipated health challenges brought by demographic and technological changes, ensuring capacity in underlying workforce in place is essential for addressing patients' needs. Therefore, a timely identification of important drivers facilitating capacity building is important for strategic decisions and workforce planning. In 2020, internationally renowned pharmaceutical scientists (N = 92), largely from the academia and pharmaceutical industry, with mostly pharmacy and pharmaceutical sciences educational background were approached (through a questionnaire) for their considerations on influencing drivers to facilitate meeting current capacity in pharmaceutical sciences research. From a global view, based on the results of the questionnaire, the top drivers were better alignment with patient needs as well as strengthening education − both through continuous learning and deeper specialisation. The study also showed that capacity building is more than simply increasing the influx of graduates. Pharmaceutical sciences are being influenced by other disciplines, and we can expect more diversity in scientific background and training. Capacity building of pharmaceutical scientists should allow flexibility for rapid change driven by the clinic and need for specialised science and it should be underpinned by lifelong learning.

Introduction

Demographic and technological changes in the 21st century inevitably bring health challenges, both locally and globally.[1] Epidemiological profiles are evolving with the rise of lifestyle-related conditions and noncommunicable diseases, ageing populations, and the emergence of new disease threats and conditions linked to climate and other environmental changes.[2] The United Nations Sustainable Development Goals (SDGs) call for good health and well-being for all (SDG 3), and universal health coverage by 2030.[3] However, it is clear nothing can be achieved without an underlying pharmaceutical workforce.[4]

Unfortunately, there is a projected staff shortfall of 18 million by 2030.[5] Especially low- and middle-income countries have human resource gaps at many levels.[6] Approximately 85% of World Health Organization (WHO) Member States report having less than one pharmaceutical personnel per 1,000 inhabitants.[6] Recent intelligence confirmed these concerns. A 2018 analysis suggests an increase in the global capacity of pharmaceutical workforce, namely pharmacists,[7] but the outlook can be bleak especially in light of workforce migration and the COVID-19 pandemic that brought widespread staffing shortages.[8] While these staff shortage projections data are primarily available for health care practitioners,[7] shortages have also affected the pharmaceutical sciences. Here routinely collected data on numbers of pharmaceutical scientists is lacking, but we see it indirectly as self-reported by life sciences companies. For 75% of them the role of their human resources has significantly transformed since the pandemic began, and 52% of them claim talent scarcity as the biggest impact on their business.[9] The demand for talent in the pharmaceutical sector is increasing in both high- and low- and middle-income countries.[10] For example, in India the attrition rate rose from 10% in 2020 to 20% in 2021 while this sector is expected to grow three times in the next decade.[11] One third of innovative pharmaceutical companies wishing to establish themselves in the Netherlands have a problem finding suitable (bio) pharmaceutical scientists.[12] Moreover, there is an urgent, growing talent gap as the skills of the pharmaceutical workforce have not yet aligned with the new world of cutting-edge therapies, such as biotechnology, precision and gene therapies, to name a few.[13,14] Influx of other disciplines and (digital) technologies will likely exacerbate this gap, for example artificial

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intelligence is expected to expand the market in global healthcare with $31.3 billion by 2025.[15] While the future lies with many uncertainties ahead, all these changes will stir the pharmaceutical landscape and consequently affect the asks for capacity building for pharmaceutical scientists.[16]

As an important group in the health and pharmaceutical sector, pharmaceutical scientists possess wide range of expertise in science and technology related to medical products. This concerns medical products' discovery and development, as well as manufacturing, regulation, and utilisation.[17] Pharmaceutical scientists are predominantly active in academia and the pharmaceutical industry, with a slightly different research focus: while basic discovery research is significantly led by academia and public research institutions funded by the government (pre-clinical stage), development, manufacturing and quality assurance is generally led by pharmaceutical industry (late- and clinical- stage).[18,19]

Building the capacity of pharmaceutical scientists to perform high-quality research which advances the knowledge base in pharmaceutical sciences, translates into new scientific discoveries and enables evidence-generation for novel therapies, is critical in order to drive continuous improvement and ultimately, to address unmet medical need.[18,20,21] "Capacity" is a broad term, interpreted and operationalized in many different ways. In a general sense, the term is understood as "the process of enhancing individual skills or strengthening the competence of an organization or set of organizations to undertake specific tasks".[22] For the purpose of this study, meeting capacity in pharmaceutical sciences research means having adequately competent and sufficiently numbered pharmaceutical scientists in place, to sustainably meet needs in new discoveries, development, clinical utilisation, marketing regulations, and the economic assessment of medical products.[23,24]

As the contribution of pharmaceutical scientists' to meeting overall health and well-being challenges through delivery of novel therapies increases, so too does the expectation that pharmaceutical scientists will continue to bring safe, effective and sustainable therapies to those who can benefit most.[24] Therefore, a timely identification of important drivers that facilitate meeting current capacity in pharmaceutical sciences research can be important for strategic decisions and workforce planning. If left unassessed, a misalignment could hinder innovation and create shortages of skilled human resources.

Therefore, the aim of this study was to gain perspectives from pharmaceutical scientists on the drivers important for meeting this capacity. We hypothesised differences between views from respondents from various educational backgrounds and affiliations exist. These views can help inform careful and strategic investing in and planning of the underlying workforce. Pharmaceutical scientists should take leadership in this process.

Methods

Participants and Settings

The International Pharmaceutical Federation (FIP), the global organization representing pharmacists and pharmaceutical scientists, is organising the Pharmaceutical Sciences World Congresses (PSWC) on a bi- or triennial basis, for the global audience of pharmaceutical sciences. The International Scientific Programming Committee carefully nominated PSWC speakers and chairs. These were the participants we approached for their thoughtful considerations and perspectives, given their international accomplishments and distinguished leadership in pharmaceutical sciences worldwide. In 2020, an online survey was sent to speakers and/or chairs (n = 380) who participated in the past three PSWC congresses: in Australia (2014), Sweden (2017) and Canada (2020, online).

Data Collection

The survey (LimeSurvey® software was used) comprised both multiple-choice and open questions. The questions were part of a wider survey on pharmaceutical sciences.[25] The first section consisted of 7 questions about the demographics of the participants (e.g., age, country, gender) and their educational background, (pharmaceutical sciences) specialty areas, position, number of years of experience, and their main affiliation(s). The second survey section inquired the perspectives of participants on 'What would facilitate meeting current capacity in pharmaceutical sciences research?' Eight pre-defined factors were selected by the research team. Each of the factors was presented to the respondents and they were asked to rate the factors on a 5-point Likert scale. Furthermore, to outline the description of/what is the pharmaceutical scientist, the current (2015) definition[17] was presented and respondents were asked whether it is still relevant via a closed question. Lastly, respondents were prompted to indicate three contemporary research questions or areas in the pharmaceutical sciences for allocation of a considerable (one million EUR/USD grant) investment.

Data Analysis

To assess if the sample was representative, the profiles of the respondents were compared with those of the speakers and chairs of PSWC we reached out to. Answer options of each of the 5-level-Likert-scale questions were analysed quantitatively (Microsoft Excel 2016 software was used). Descriptive statistics were applied. Numerical scale was used − 5 points were allocated to "very important" and 1 point to "not at all important" responses, and these were analysed by describing frequencies. The mean and standard deviation were determined with the objective to assess how the elements contributed equally to the total scale score. Additionally, analyses were stratified for the most prevalent groups: participants coming from academia and from pharmaceutical industry, and participants with pharmacy (meaning with the education leading to legal right to license pharmacy) and from pharmaceutical sciences (meaning with the education in areas with a focus on pharmaceuticals, but not necessarily leading to legal right to license pharmacy) educational background. The open questions' answers were analysed and arranged into relevant themes.

Results

Demography

Ninety-two responses were received out of 380 invitations sent (response rate 24% after 2 reminders). The profile of the respondents and the overall group of speakers/chairs who were approached for the survey are displayed in Table 1.

Gender and geographical region were similar in both groups. The respondents self-reported to mostly have pharmaceutical sciences (n = 43, 47%) and pharmacy (n = 22, 24%) educational backgrounds, similar to the original group. The majority of participants' affiliations were from academia (n = 64) and a large part came from pharmaceutical industry (n = 17). A few participants (<5%) among these indicated affiliation to both academia and industry. Similarly, the initial surveyed group of all invited respondents consisted primarily of representatives from academia (n = 242, 64%) and the industry (n = 54, 14%).

Perspectives on the Drivers Facilitating Meeting Current Capacity in Pharmaceutical Sciences

In Fig. 1 the results of the question "What would facilitate meeting current capacity in pharmaceutical sciences research?" Are summarised in a graphical overview.

Table 1
Characteristics of the pharmaceutical scientists who participated in the study (n = 92) and in the originally surveyed group (n = 380).

	Respondents No. (%) N = 92	Surveyed group No. (%) N = 380
Gender		
Female	25 (27)	96 (25)
Male	64 (70)	284 (75)
Undisclosed	3 (3)	0 (0)
Geographical region [a]		
European	37 (40)	145 (38)
Americas	30 (33)	136 (36)
Western Pacific	19 (21)	88 (23)
Other	6 (6)	11 (3)
Affiliation [b]		
Academia	64 (70)	242 (64)
Industry	17 (18)	54 (14)
Non-governmental and/or public institution	6 (7)	8 (2)
Governmental institution	5 (5)	20 (5)
International body	5 (5)	7 (2)
Healthcare	5 (5)	18 (5)
Private research institution	4 (4)	5 (1)
Philanthropic foundation, charity	3 (3)	6 (2)
Regulatory, quality control	1 (1)	19 (5)
Other	2 (2)	1 (0)
Educational background (highest degree)		
Pharmaceutical sciences	43 (47)	
Pharmacy	22 (24)	
Chemistry (medicinal)	5 (5)	
Biology, biotechnology	5 (5)	
Biophysics/physics	3 (3)	
Medicine, epidemiology	3 (3)	
Other (e.g., data science, humanities)	11 (12)	
Academic / professional rank / position		
Full professor	42 (46)	
Research director, management lead	19 (21)	
Associate professor, senior researcher	12 (13)	
Postdoc, junior researcher	8 (9)	
PhD student	6 (7)	
Other	5 (5)	
Pharmaceutical sciences specialty area (current)		
Drug formulation, pharmaceutics	29 (32)	
Clinical pharmacology, drug development	17 (18)	
Health systems, policy, regulation	13 (14)	
Clinical pharmacy, pharmacy practice	10 (11)	
(Cell) biology, systems biology, disease models	8 (9)	
(Medicinal) chemistry, drug discovery	6 (7)	
Pharmacology, drug action	5 (5)	
Analytical sciences and quality control	4 (4)	
Number of years of experience		
40+	20 (22)	
30+	22 (24)	
20+	17 (18)	
10+	12 (13)	
≤10	21 (23)	

[a] Based on World Health Organisation (WHO) regions.
[b] Not mutually exclusive groups.

The respondents indicated better alignment with clinic and with patients as the top one very important factor; followed by (2) lifelong learning, and (3) more specialization, investment in deep knowledge in the top three very important factors. Increased influx of pharmacists, i.e. pharmacy graduates was selected the least. Furthermore, in Table 2 the answers are stratified by professional (academia, industry) and educational (pharmaceutical sciences, pharmacy) background.

The same factors were selected by participants from the academia and from the industry. For the educational background stratification, there was a slight change for participants with pharmaceutical sciences educational background. For them lifelong learning was more profound, being the leading factor. These participants also indicated funding/entrepreneurial opportunities to pursue a research career path as very important for building capacity in the top three factors. Alignment with the clinic was following these, sharing fourth place with co-training with data scientists and MedTech experts.

Perspectives on the Scope of Pharmaceutical Sciences

When presented with the latest available definition of a pharmaceutical scientist (from 2015)[17], 61 (66%) respondents found it still valid, while approximately one third of all respondents felt that this definition should also incorporate more clearly a patient 20 (22%) or disease 11 (12%) focus.

A total of 224 ideas was received for the open question on contemporary research questions/areas in the pharmaceutical sciences. Out of this only 2 responses (0.9%) were devoted to capacity building and education.

Discussion

As confirmed through a unique perspective from pharmaceutical scientists from around the world who were respondents in our survey, critical drivers to facilitate meeting current capacity in pharmaceutical sciences research are better alignment with the patient needs as well as strengthening education − both through continuous (lifelong) learning and deeper specialisation. Building capacity in pharmaceutical sciences research is necessary for addressing the patients' needs where needed the most.[24]

But before we think of "how", we need to answer "what" − what/who are pharmaceutical scientists? Looking at the educational background of our pharmaceutical scientist- respondents, pharmacists are not the largest group. In fact, less than a quarter indicated having a pharmacy educational background and our results reflect the general mix of educational backgrounds of pharmaceutical scientists. Nearly half of the participants indicated having a pharmaceutical sciences background. Nearly one third indicated various other areas, for example (medicinal) chemistry; biology, biotechnology; medicine, epidemiology; data science, statistics; biophysics/physics; engineering; social sciences, humanities or other areas. Scientific programme areas, as well as divisions and sections from regional organisations of pharmaceutical sciences, show a similar picture.[26-28] For example, only 5% of the members of the American Association of Pharmaceutical Scientists hold a clinical pharmacy degree (PharmD) in contrast to various master's (18%) and bachelor's (16%) degrees and PhDs (61%). Their field of study was listed as Pharmaceutics/Pharmacy for only 3% (in contrast to various basic- or advanced- sciences fields).[28] Rowland et al recognised that pharmaceutical science, the science behind the discovery, development, production and use of medicines, is possibly one of the most complex undertakings of mankind.[29] It often requires competencies from different traditional fields of sciences.[29] This corresponds to the background of the pharmaceutical scientists in our sample, that is based on a wide range of disciplines, where pharmacy is only one of many. Indeed, pharmaceutical science is key to the development of new medicines, with roles in formulation and development, drug delivery, product manufacture and quality control, quality assurance and regulatory affairs, to name but a few. In the past, pharmacists often found a career within such roles, using the science content of their pharmacy degree to contribute to the quality and innovation of new medicines.[30] Nowadays, with pharmacists becoming more focused on clinical roles, the development of medicines relies increasingly on pharmaceutical scientists who may have a background in a wide variety of sciences, but not necessarily pharmacy.[31] In fact, scientists with varying backgrounds are needed to contribute to drug discovery, development, delivery, manufacturing and regulatory processes. Scientists with backgrounds in computational technologies such as artificial intelligence/data science, biology, biotechnology, engineering etc. are those needed to achieve the necessary increase in the pharmaceutical science workforce.[12]

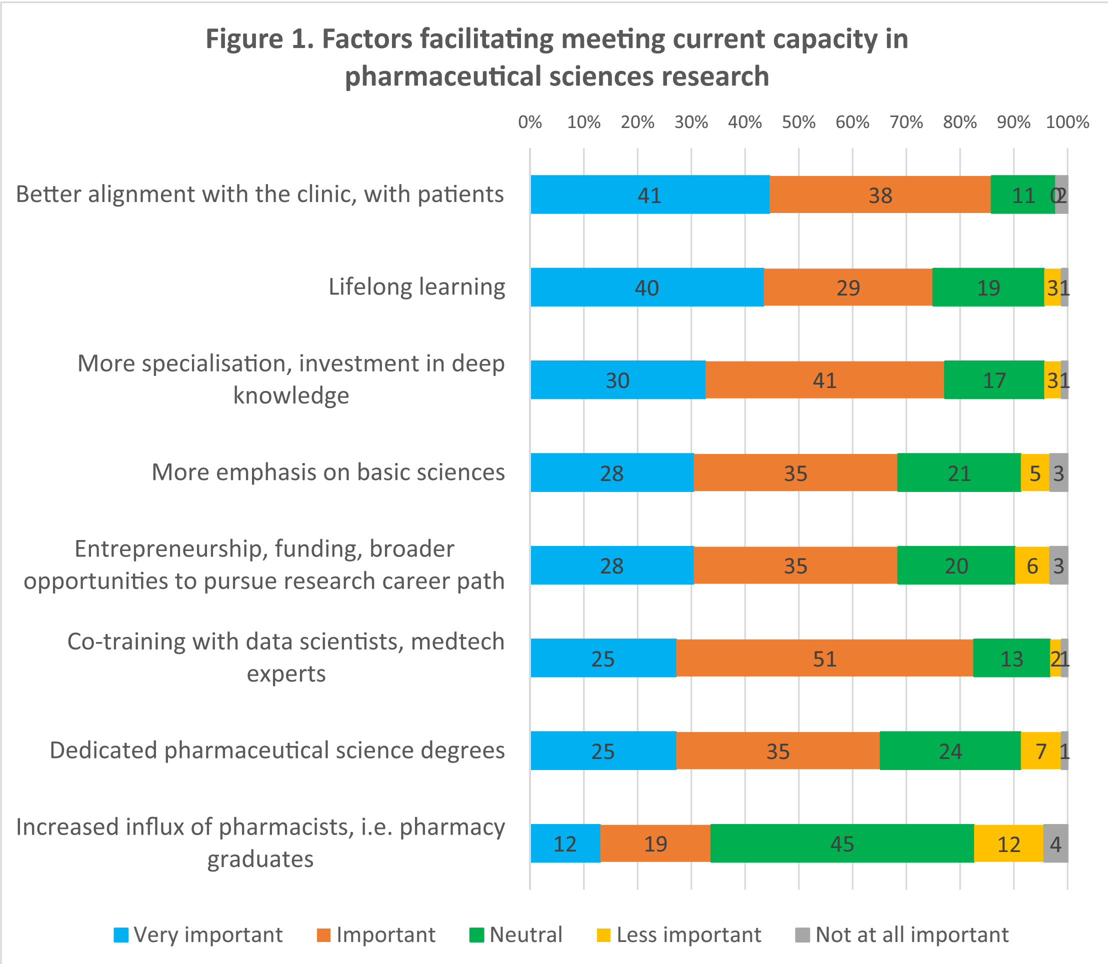

Figure 1. Factors facilitating meeting current capacity in pharmaceutical sciences research.

Pharmaceutical sciences are being influenced by other disciplines, and this trend will most likely continue. Therefore, to support capacity building in light of this trend, academic institutions should establish early collaboration with the medicines development units, the pharmaceutical industry and government agencies.[30,32,33]

As part of the "how" in meeting the current capacity in pharmaceutical sciences, it is encouraging to see that alignment with clinical need is a key driver for building capacity. A recent scenario analysis, a scientific method designed to outline multiple futures (scenarios) to create an overview of plausible futures that can be used for strategic planning, depicted alternative futures for the pharmaceutical landscape for the upcoming decade. The results of this analysis emphasize that while clinical needs as such may not disappear, different approaches will be needed for different scenarios.[16] For example, the future we may witness can be dividing towards or away from high-end medicines (costly medicines such as cancer or rare diseases treatment).[16] The latter direction, away from such medicines, may lead to science less in the lab and more "in translation" with pharmaceutical clinicians in primary health care (with common desire for more quality of life through palliative care). Therefore, being adaptable to where capacity is needed will be a vital approach. The good news is that clinical (unmet medical) need is important in priority setting, funding and impact in pharmaceutical sciences − and continued prioritisation of research towards these can address them where needed the most.[25] The definition of the pharmaceutical scientist and what this term is encompassing[17] may need to change accordingly, closer to the disease or to the patient, as indicated by our respondents.

Specialisation, identified as the second very important factor in the present study, calls for investment in deep, contemporary, cutting-edge knowledge. For example, in the increasingly important area of personalised medicine, pharmaceutical scientists will need to obtain specialist knowledge on genomics and the genetic basis for disease and treatment.[34] As outlined by the previously mentioned scenario analysis, specialists are sought for especially in an environment of global/international collaboration and consistency. They are then supported by widespread optimism about the role of science and entrepreneurship for bringing health benefits to society and blooming open science.[16] In this scenario, areas like biotechnology will be particularly thirsty for new talent.[35] But in case of a scenario of local- and national-isms, and increased global fragmentation,[16] will the demand shift towards generalists and multitaskers? If countries are "on their own", resolving supply chain gaps and unequal access can quickly become an urgency, leaving less space for deep specialisation. For example, increased "localism" during the recent pandemic has witnessed severe drug shortages, which enhanced increased drug repurposing as a response.[36] These lessons can be used for future preparedness.

The above demonstrates that capacity building is not an easy task. In order for it to be translating into real world/practice changes, a long term and early planning is needed − which is at the same time

Table 2
Rating of the factors facilitating meeting current capacity in pharmaceutical sciences research, stratified for professional (academia, industry) and educational (pharmaceutical sciences, pharmacy) background.

Drivers:	Nr. order [a]	Mean (SD) [b]	Very important, No. (%)	Important, No. (%)	Neutral, No. (%)	Less important, No. (%)	Not at all important, No. (%)
Better alignment with the clinic[c]	#1	4.3 (0.8)	41 (45)	38 (41)	11 (12)	0 (0)	2 (2)
Academia	#1	4.3 (0.9)	29 (45)	26 (41)	7 (11)	0 (0)	2 (3)
Industry	#2	4.3 (0.7)	8 (47)	6 (35)	3 (18)	0 (0)	0 (0)
Pharmacy	#1	4.5 (0.7)	14 (64)	6 (27)	2 (9)	0 (0)	0 (0)
Pharm. sciences	#4	4.0 (0.8)	13 (49)	21 (49)	8 (19)	0 (0)	1 (2)
Lifelong learning[c]	#2	4.1 (0.9)	40 (43)	29 (32)	19 (21)	3 (3)	1 (1)
Academia	#2	4.0 (0.9)	23 (36)	25 (39)	12 (19)	3 (5)	1 (2)
Industry	#1	4.2 (0.9)	9 (53)	2 (12)	6 (35)	0 (0)	0 (0)
Pharmacy	#3	4.0 (0.9)	8 (36)	7 (32)	6 (27)	1 (5)	0 (0)
Pharm. sciences	#1	4.1 (0.9)	16 (37)	17 (40)	8 (19)	2 (5)	0 (0)
More specialisation, investment in deep knowledge[c]	#3	4.0 (0.9)	30 (33)	41 (45)	17 (18)	3 (3)	1 (1)
Academia	#3	4.0 (0.9)	19 (30)	28 (44)	14 (22)	2 (3)	1 (2)
Industry	#3	4.3 (0.7)	7 (41)	8 (47)	2 (12)	0 (0)	0 (0)
Pharmacy	#2	4.2 (0.7)	9 (41)	9 (41)	4 (18)	0 (0)	0 (0)
Pharm. sciences	#2	4.0 (0.9)	15 (35)	16 (37)	10 (23)	1 (2)	1 (2)
More emphasis on basic sciences[c]	#4	3.9 (1.0)	28 (30)	35 (38)	21 (23)	5 (5)	3 (3)
Academia	#4	3.9 (0.9)	19 (30)	26 (41)	14 (22)	4 (6)	1 (2)
Industry	#7	3.7 (1.0)	4 (24)	6 (35)	6 (35)	0 (0)	1 (6)
Pharmacy	#5	3.6 (1.1)	7 (32)	4 (18)	8 (36)	2 (9)	1 (5)
Pharm. sciences	#7	4.0 (0.9)	12 (28)	22 (51)	6 (14)	2 (5)	1 (2)
Entrepreneurship, funding, broader opportunities to pursue research career path[c]	#5	3.9 (1.0)	28 (30)	35 (38)	20 (22)	6 (7)	3 (3)
Academia	#7	3.7 (1.1)	17 (27)	25 (39)	13 (20)	6 (9)	3 (5)
Industry	#6	4.0 (0.8)	5 (29)	7 (41)	5 (29)	0 (0)	0 (0)
Pharmacy	#7	3.6 (1.1)	5 (23)	7 (32)	7 (32)	2 (9)	1 (5)
Pharm. sciences	#3	4.0 (1.0)	15 (35)	18 (42)	5 (12)	4 (9)	1 (2)
Co-training with data scientists, medtech experts[c]	#6	4.1 (0.8)	25 (27)	51 (55)	13 (14)	2 (2)	1 (1)
Academia	#6	4.0 (0.8)	17 (27)	34 (53)	10 (16)	2 (3)	1 (2)
Industry	#4	4.2 (0.7)	6 (35)	8 (47)	3 (18)	0 (0)	0 (0)
Pharmacy	#6	4.0 (0.7)	5 (23)	13 (59)	3 (14)	1 (5)	0 (0)
Pharm. sciences	#5	4.1 (0.8)	13 (30)	21 (49)	8 (19)	1 (2)	0 (0)
Dedicated pharmaceutical science degrees[c]	#7	3.8 (1.0)	25 (27)	35 (38)	24 (26)	7 (8)	1 (1)
Academia	#5	3.8 (0.9)	19 (30)	21 (33)	19 (30)	5 (8)	0 (0)
Industry	#5	4.1 (0.8)	5 (29)	9 (53)	2 (12)	1 (6)	0 (0)
Pharmacy	#4	4.0 (0.9)	7 (32)	8 (36)	6 (27)	1 (5)	0 (0)
Pharm. sciences	#6	3.9 (0.9)	12 (28)	17 (40)	12 (28)	2 (5)	0 (0)
Increased influx of pharmacists, i.e. pharmacy graduates[c]	#8	3.3 (1.0)	12 (13)	19 (21)	45 (49)	12 (13)	4 (4)
Academia	#8	3.2 (1.0)	7 (11)	12 (19)	32 (50)	10 (16)	3 (5)
Industry	#8	3.5 (0.8)	3 (18)	4 (24)	9 (53)	1 (6)	0 (0)
Pharmacy	#8	3.2 (1.0)	3 (14)	3 (14)	13 (59)	2 (9)	1 (5)
Pharm. sciences	#8	3.3 (1.0)	7 (16)	10 (23)	18 (42)	7 (16)	1 (2)

[a] *Order of the drivers that scored highest in the category very important, out of 8 drivers.*
[b] *Based on a 5-point Likert Scale on which 1 = not at all important and 5=very important.*
[c] *92 participants answered.*
Abbreviations: SD = standard deviation, pharm. sciences = Pharmaceutical sciences.

difficult given the future direction of clinical needs is uncertain. Each transformation requires a diverse workforce that is prepared to provide leadership for change and lead the process to keep pace with continuous changes in science and patient needs.[18,37] This remains difficult, as even though we can assume future scenarios, the environment is fast-changing and, unfortunately, the field (academia, industry) is notoriously slow in responding.[38,39] Changes in academic programmes for pharmacy and pharmaceutical sciences, especially the big curriculums revisions, do not happen often enough.[39-44] In addition, academia tends to focus on undergraduate students. But how about the out-of-university workforce? Lifelong learning is very important, the top one factor for respondents coming from the industry as well as the ones with pharmaceutical sciences educational background. Indeed, industry and umbrella organizations are often filling the gaps, offering lifelong learning programmes to the practicing workforce.[45] Similarly, excellent PhD programmes and certified post-graduate courses offering a range of specialized training in varying areas could contribute to the solution, such as recent efforts from a drug safety professional training programme in Europe.[46] Similar programmes are needed to meet the drug development needs. On the opposite side, our respondents indicated that the influx of pharmacists, i.e. pharmacy graduates, was the least important factor, likewise in each of the sub-groups. This is surprising as recruiting new people is often what comes to mind first when talking about workforce shortage. One explanation could be that pharmacy and pharmaceutical education globally continues to face many issues that challenge the quality of teaching and learning at a time when there are limited resources to meet these challenges. An example of these challenges is rapid expansion in the number of schools of pharmacy and pharmaceutical sciences in some countries in light of demographic changes.[37,47-49] One effort to address the quality issue is an accreditation process for pharmaceutical sciences courses, as well as use of competency frameworks.[50] Another effort is to inform and shape capacity and workforce development through workforce intelligence activities. Workforce intelligence, collecting and analysis data on numbers in workforce labour, can directly contribute to realistic policy formation and workforce planning. Pharmaceutical workforce data over the 2006−2016 period were analysed,[7] expressed in the number of pharmacists per 10,000 population. However, in contrast to the regulated (licensed) pharmacy profession, there are no available data on numbers of pharmaceutical scientists. Yet, workforce planning would greatly benefit from collating and integrating data for the full range of the pharmaceutical workforce.[7] While out of scope for this study, collecting and analysing data on pharmaceutical scientists' capacity, including employment area, career pathways, density, distribution, and interactions with national or regional disease burden (as well as the impact of disease trends) are all needed in order to inform national strategic pharmacy workforce planning, including requirements for influx of graduates. The results of this survey could help this purpose.[7] Global umbrella organisations could take a leadership in this endeavour to inform evidence-driven capacity building policies.

All in all, building capacity − and doing it right − is vital and should be on top of peoples' minds.[24] There is increasing recognition of the need for a well-informed, strategic approach to building capacity. Unfortunately, with hardly one per cent of ideas on research questions and areas provided by our respondents were devoted to building capacity, we have to conclude this is not the case. Nevertheless, "academic capacity" is one of the FIP Development Goals, positioned in the first place among other goals.[51] In addition, the three outlined mechanisms for the scientific component of the FIP DG#1 is to *[. . .] collaborate with academic leaders [. . .] and the pharmaceutical industry to define regional and global needs for the pharmaceutical sciences*.[51] Further studies on this topic could bring the significance of this topic to the attention of the international community to meet these ambitious goals, with the ultimate aim to respond to the needs of the societies.

Strengths and Limitations

As a major strength of this study, it offers a global perspective from well-established pharmaceutical scientists with distinguished leadership and international accomplishments. As for limitations, firstly, the sample group was identified by a single global pharmaceutical federation. Therefore, the geographical regions were not equally represented, and the opinions of general (and especially early career) researchers may not be reflected. Secondly, as the respondents were largely having academic or industrial affiliation, we need to keep in mind that the industry group respondents often have a history in academia. Due to lack of the data on the educational background of the original group we reached out to, we were not able to compare this parameter with the surveyed group. However, for the other parameters the representation seemed to be well corresponding so there is no indication this would be different for educational background. Thirdly, while workforce numbers is an important area for capacity building, this was out of scope for this study. Finally, the responses were collected in 2020 amid the pandemic and this may have affected the responses/priorities and response rate. Despite these limitations, the study offers expert perspectives from different regions and pharmaceutical sciences areas and coherent themes that emerged from these perspectives.

Conclusions

This study shows that capacity building in the pharmaceutical sciences is more than simply increasing the influx of graduates. The need for more pharmaceutical scientists, from the lab to the clinic, from basic sciences drug discovery to drug development, manufacturing and quality assurance, will increase in the next decades. Based on our study findings we may expect more diversity in training. It is clear that scientists with varying backgrounds are needed to address the imminent research issues. Where pharmaceutical scientists can make a difference, they will fill relevant positions. The same will be true for clinical experts − historically, trained pharmacists have had synergistic and bridging roles in the pharmaceutical sciences and given high levels of specialisation within the field more than ever before, we expect that will continue to happen. Capacity building should embrace these when planning of the underlying workforce, with commitment to sustained and life-long learning.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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