



Clinical pharmacologist from the eyes of a clinical pharmacist: a questionnaire-based survey

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Abstract

Introduction Management of a clinical condition is patient centric. Interdisciplinary coordination plays an influential role in patient management. Pharmacology deals with the study of drugs. Clinical pharmacology deals with applied aspects of pharmacology in addition to clinical research.

Methodology We set up a survey to assess the perceptions of clinical pharmacologists (CPs) regarding their roles and about clinical pharmacology courses in India. The survey was administered via a Google questionnaire sent via LinkedIn, Email, or WhatsApp to 100 CP's working in India.

Results Respondents to the questionnaire were working as CPs. They were either postgraduate in pharmacology (MD pharmacology (doctor of medicine in pharmacology) 60.2%) or had a super-specialization degree in clinical pharmacology (DM clinical pharmacology (doctorate in medicine in clinical pharmacology) (34.7%)) or other pharma postgraduates. They were working in pharmaceutical companies (41.8%), hospitals (26.5%), or academic institutions (30.6%). When the responses from the respondents were stratified by qualification or experience, they showed that most of the CPs felt that the CPs played a significant role in academia, pharmaceutical organizations, hospitals, and drug regulatory bodies.

Conclusions All the CPs opined that training during the postgraduation course was not sufficient to be qualified as CP. There was no consensus among the CPs on the benefit of existing certification courses in clinical research. However, they felt that the centres offering these courses should be accredited, and the curriculum should be uniform. Respondents opined that CPs' patient management role could be improved by collaborating with clinicians and organizing workshops and conferences.

Keywords Clinical pharmacology · Clinical pharmacist · Pharmacology · Post-graduation · Survey

Introduction

Detailed interpretation of drug pharmaceutical, pharmacokinetic, pharmacodynamic, and therapeutic phase data is essential to ensure the appropriate use of drugs. A clinical pharmacist is a medical professional trained in the multidisciplinary aspects of pharmacology and clinical research to develop new drugs and their role in hospital patient management [1]. A medical pharmacist is a medical

graduate who completed a postgraduation/master degree in pharmacology. A clinical pharmacist is a health professional and an expert on drugs who plays a significant role in health care, especially in the hospital [2].

After graduating from medical school, medical students can pursue a 3-year postgraduate degree in pharmacology (doctor of medicine, MD), during which they will be trained in pharmacology, applied pharmacology, and a few areas of clinical pharmacology [3]. A postgraduate degree in pharmacology can lead to employment opportunities in scientific sectors like research and development, and hospitals. After completing the postgraduate pharmacology course, a 3-year program for super specialization in clinical pharmacology (doctorate of medicine, DM) is also available in India, which is similar to a Ph.D. program in Western countries, during which they will learn more about the clinical applications of pharmacology, pharmacodynamics, pharmacokinetics, pharmacovigilance, drug development, and in-depth clinical research knowledge [4].

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The MD pharmacology course curriculum differs from that required for clinical pharmacologists in the pharmaceutical industry [5]. This gap can be a crucial factor in their career. With experience over time, a medical pharmacologist can become a clinical pharmacologist (CP). Internationally, there are concerns about the strategies to address clinical pharmacology education and prescribing competence in medical graduates [6].

In addition to their role in the hospitals, drug regulatory bodies require a clinical pharmacologist (CP) for health technology assessments, monitoring, and inspection of clinical research activities undertaken in the country, etc. Accordingly, the expectations of regulatory bodies from CPs vary, depending on the job profile [7]. Many young medical pharmacologists are interested in drug development in the pharmaceutical industry. The work profile of clinical pharmacologists is very varied, and they are expected to play multiple roles in industry, academia, and research [8, 9]. Hence, considering the lack of knowledge of CP's job requirements, many pharmacologists opt for training in clinical research. Different courses are available for students aspiring in clinical research to bridge the knowledge gap. However, no uniformity in the training curriculum leads to a confused state of mind for the employees or organizations when they hire these so-called CPs. In addition, the course duration and the fee structure of these courses vary greatly. We surveyed 100 clinical pharmacologists regarding their roles and responsibilities in their workplace. The survey also involved their opinions on the clinical pharmacology teaching curriculum and suggestions to improve awareness and the workforce.

Methodology

After discussion with expert clinical pharmacologists and pharmacologists, we developed a questionnaire with the primary objective of capturing the roles played by clinical pharmacologists in India. The questionnaire was composed of 19 questions: yes/no, multiple-choice, or multiple select. Our institutional ethics committee approved the study. Subsequently, we designed the final survey questionnaire on Google Forms. The link to the survey questionnaire was sent to the CPs through social media—LinkedIn, WhatsApp, and email. We collected the responses to the questionnaire from 100 participants, with the inclusion criteria being CPs of either gender who were willing to participate in the survey and complete the questionnaire. The questionnaire also included a question regarding their consent for participation in the survey. Consented participants completed the survey questionnaire, and their responses were considered for analysis.

Statistical analysis plan

In the survey questionnaire, most questions were either multiple choice or multiple select types. The survey results were analyzed using Microsoft Excel 2022 and IBM SPSS Stat.0 version. The responses to the survey questions are presented as frequencies and percentages. Overall, as well as group percentages, are provided to understand the scarcity in the course curriculum of the CPs. The groups are formulated by their qualifications (MD, DM, & others) and years of experience (< 5 years & ≥ 5 years). The respondents' work experience is presented as mean and standard deviation for each group.

Results

One hundred participants working as clinical pharmacologists in different sectors provided their responses to the survey questionnaire. Of the 100 respondents, one participant did not provide consent for the survey after initiation, and one participant was still pursuing his postgraduation in medical pharmacology. So, the final data set includes the responses of 98 participants. Table 1 contains the details of the participants and their answers.

Respondents were either postgraduates in pharmacology (doctor of medicine (MD) in pharmacology) or those with a super specialization degree in clinical pharmacology (doctorate in medicine (DM) in clinical pharmacology) or those with a Pharm-D degree. DM clinical pharmacologists (DM CPs) are pharmacology postgraduates who have completed a 3-year super specialization in clinical pharmacology and therapeutics as subjects and are trained in various aspects of clinical research, medical affairs, pharmacovigilance, therapeutics, etc. Survey respondents comprised 60.2% MD pharmacologists (MD CPs), 34.7% DM clinical pharmacologists (DM CPs), and the rest were PharmDs (Table 1). 74.5% of the participants opined that more trained CPs are required. 32.7% (32 of 98) of the respondents felt that the additional certificate courses were not valuable, of which 53% (i.e., 17 of 32) were MD CPs, and 41.2% (i.e., 14 of 32) were DM CPs. Among the CPs who completed certification courses, courses offered by private organizations were preferred over those provided by Government organizations (66.6 vs. 33.4%, respectively, for private and government institutions). Among all the participants, 96.9% agreed that there is a need to increase awareness of clinical pharmacology nationally and internationally. About 50% (49 of 98) of the respondents opined that the additional certificate courses in the clinical research were beneficial, of which 34 responses were from MD CPs (Table 1).

Table 1 Responses given by the clinical pharmacologists to the survey questions

Question details	Characteristics	n	%
Qualification of the respondents	MD pharmacology	59	60.2
	DM clinical pharmacology	34	34.7
	Others	5	5.1
Respondent's place of work	Pharmaceutical company	41	41.8
	Hospital	26	26.5
	Academic institution	30	30.6
	Drug regulator	1	1
Professional experience of respondents (years) (median, range)		6 (0–45)	
Clinical research activities they undertake as part of their job	Clinical trial operations—conducting clinical trials and data management	63	64.3
	Committee member who reviews and approves new drug applications	18	18.4
	Committee member who reviews and approves clinical research studies	42	42.9
	Pharmacovigilance-related activities	69	70.4
	Development of standard treatment guidelines in collaboration with different clinical departments, including antibiotic policy	24	24.5
	Training students in clinical pharmacology	62	63.3
	Pharmacometrics	11	11.2
CPs who responded no to the question that “the number of clinical pharmacologists was adequate in India.”		72	73.4
CPs who responded yes to the question of “whether the clinical pharmacologists are getting adequate support or representation in government organizations, academia, and pharmaceutical organizations.”		8	8.2
The responses given by the CPs to the question regarding the adequacy of clinical pharmacology training in the course curriculum of PG	Agree	15	15.3
	Neutral	15	15.3
	Disagree	68	69.4
CPs who responded yes to the question about whether it is advantageous to have a certificate course in clinical pharmacology	Agree	49	50
	Neutral	17	17.3
	Disagree	32	32.7
CPs who had any certifications other than those related to clinical pharmacology	Private	52	53.1
	Government	36	66.7
CPs who had the benefit of having certifications for the career growth (n=52)		18	33.3
Responses given by the CPs to the question regarding the uniformity of course curricula of the extra certifications provided by all the centers on the clinical pharmacology teaching programs	Agree	44	84.6
	Neutral	71	72.4
	Disagree	18	18.4
Responses given by the CPs to the question regarding the inclusion of curriculum of additional clinical pharmacology courses in the course of PG pharmacology teaching programs	Agree	9	9.2
	Neutral	80	81.6
	Disagree	12	12.2
	Disagree	6	6.1

Table 1 (continued)

Question details	Characteristics	n	%	
The response given by the CPs to the question regarding the situations where a clinical pharmacist plays a significant role	Academia	91	92.9	
	Pharmaceutical organizations	97	99	
	Government regulatory bodies	92	93.9	
	Hospitals	90	91.8	
	All	82	83.7	
	OPD consultation	61	62.2	
	Ethics committee consultation	88	89.8	
	Clinical trial designing	90	91.8	
	Clinical trial auditing & inspection	89	90.8	
	Pharmacovigilance	88	89.8	
The response from CPs to the question regarding the roles played by a clinical pharmacist in a hospital?	Prescription audit	92	93.9	
	Therapeutic drug monitoring	94	95.9	
	All	51	52	
	CPs who responded yes to the question that there is a need to increase the awareness of clinical pharmacology nationally as well as internationally	Increase awareness among other specialties by healthy collaborations, organizing workshops and conferences	95	96.9
		Organizing clinical pharmacology outpatient clinics in specialty hospitals	93	94.9
		Increase awareness among the government representatives and medical councils to create posts and a career path for clinical pharmacologists	70	71.4
		Special courses for aspiring students in government and private institutes	79	80.6
		Student exchange/training programs with the universities in overseas for doctoral or research fellowship studies	52	53.1
		Provide evidence to the hospital management of the cases managed by clinical pharmacologists	65	66.3
		All	71	72.4
The responses given by the CPs to the question regarding the methods to increase the awareness of clinical pharmacology?		All	32	32.7

CP clinical pharmacist, DM doctorate of medicine, MD doctor of medicine, OPD outpatient department, PG postgraduation

Respondents were categorized based on experience as those with < 5 years or ≥ 5 years. There were 38 and 60 respondents in the respective groups with an average duration of the experience of 2.62 ± 1.395 years and 13.33 ± 9.39 years, respectively. In the DM CP group and MD CP group, there was an equal number of CPs with ≥ 5 years' experience (46.7% vs. 50.0%) (Table 2).

Our results show that, regardless of the duration of experience of the CPs, all opined that CPs are not getting adequate support or representation in government, academia, and pharmaceutical organizations and that they have a multidisciplinary role in the health sector as in hospital activities, outpatient department (OPD) consultations, pharmacovigilance and prescription audit, and therapeutic drug monitoring. In addition, the results show that CPs play a significant role in the ethics committee proceedings, clinical trial designing, auditing, and inspections (Table 2).

A significantly higher proportion of MD CPs was working in the pharmaceutical industry compared to DM CPs (50.8% vs. 29.4%) (Table 3). Among the DM CPs, 35.3%, 32.4, and 29.4% had positions in educational institutions, hospitals, and pharmaceutical companies, respectively. In contrast, among the MD CPs, a majority (50.8%) were employed by pharmaceutical companies. Regarding the course curriculum in postgraduation, 43 of 59 and 23 of 34 MD and DM CPs, respectively, opined that it is not up to the requirement of a CP. This conclusion was the same when the responses were categorized regardless of the duration of the responding CPs' experience. Among the 98 participants, 55 (56.1%) had at least one additional certificate course related to clinical research, of whom 35 (59.3%) were MD CPs and 16 (47.1%) were DM CPs. Among those with certifications, 44 (84.6%) agreed, and 8 (15.4%) disagreed about the benefits of these certifications on their career growth. This response was robust, regardless of the responding CP's qualification. Based on their experience, respondents felt that CPs play a significant multidisciplinary role in academia, pharmaceutical companies, hospitals, and regulatory bodies. When the results were classified based on their qualification, 45 of 59 (76.3%) MD CPs and 32 of 34 (94.1%) DM CPs opined that their role was multidisciplinary.

Regarding the roles a CP plays in a hospital, 27 of 59 (45.8%) MD CPs and 21 of 34 (61.8%) DM CPs opined that CPs could play multiple roles. Compared to MD CPs, more DM CPs opined that they could do OPD consultations in a hospital (32 of 59 vs. 26 of 34, i.e., 76.5% vs. 54.2%) (Table 3). A similar observation was noted when their responses were stratified based on their qualification and experience.

Regarding the course curriculum, most of the CPs felt the need and importance of uniformity in the certification courses offered by all the centers. In addition, they also opined that the content of these courses should be part of the postgraduation courses. The results were similar when stratified by participants' qualifications or experience (Table 2).

Discussion

In this study, we captured the responses and opinions of clinical pharmacologists from India working in different fields as clinical pharmacologists via a questionnaire. Pharmacology postgraduation (MD pharmacology) is a 3-year course pursued after a medical student completes their graduation from medical school. During the course, they will be taught pharmacology, applied pharmacology, and a few aspects of clinical pharmacology. A pharmacology degree can open up careers in scientific areas like research and drug development. After medical graduates complete their postgraduation in pharmacology, they will be eligible to pursue a super specialty course in clinical pharmacology (DM clinical pharmacology & therapeutics), a 3-year program. During the course, students will be trained in more of the clinical aspects of pharmacology—pharmacokinetics, pharmacodynamics, pharmacovigilance, drug development, and in-depth knowledge of clinical research. We observed from our study results that the course curricula in the postgraduation need to be updated. In addition, we also observed that the respondents felt that the existing course curricula were not as per the requirements for future clinical pharmacologists' roles and responsibilities.

Based on prior experience and after discussions with experts, the British Pharmacological Society (BPS) has developed a core curriculum in pharmacology for undergraduates. The factors considered by them were in line with the observations made in our survey [10]. BPS also stressed the need for a dynamic pharmacology curriculum. Dikshit RK from India opined that the existing curriculum of clinical pharmacology training is inadequate and needs to be updated, which matches our survey results too [11]. In 2006, the European Union of Medical Specialists (UEMS) designed specialized additive training for medical graduates. The course contained an equal duration of 18 months of training in pharmacology and clinical pharmacology. Subsequently, in 2015, additive specialty was replaced by specialization in clinical pharmacology. As observed in our study, Melissa J. Wallace from Swansea University and Subhrojyoti Bhowmick from India also opined that a more significant number of expert clinical pharmacologists is needed to cope with the recent surge in clinical research activities in industries, hospitals, and academic institutes [12]. Our results also show that CPs are not getting adequate support or representation in government, academia, and pharmaceutical organizations. This observation implies that there should be a sufficient number of CPs in these organizations for effective drug development.

Simon Maxwell and Tom Walley, ex-Vice President and ex-Chairman of the clinical section committee of the British Pharmacology Society, stressed the importance of training medical graduates in clinical pharmacology. They suggested that training in safe, effective, and cost-effective drug prescribing methods was needed for medical graduates. Considering clinical pharmacologists' roles in patient management, the authors opined that clinical pharmacology and therapeutics (CPT) as

Table 2 Responses based on the experience of the clinical pharmacologists

Characteristics with respect to the duration of the experience		< 5 years (%)	≥ 5 years (%)
Qualification	MD pharmacology	29 (76.3)	30 (50)
	DM clinical pharmacology	6 (15.8)	28 (46.7)
	Others	3 (7.9)	2 (3.3)
Place of work	Academic institution	16 (42.1)	14 (23.3)
	Hospital	9 (23.6)	17 (28.3)
	Pharmaceutical company	13 (34.2)	28 (46.6)
	Drug regulator	0 (0.0)	1 (1.6)
Advantageous to have a certificate course in clinical pharmacology	Agree	22 (57.9)	27 (45)
	Neutral	6 (15.8)	11 (18.3)
	Disagree	10 (26.3)	22 (36.7)
Have certifications other than those related to clinical pharmacology (<i>n</i> = 52)	Certification is beneficial to career growth	17 (89.4)	27 (81.9)
	Certification is not beneficial to career growth	2 (10.5)	6 (18.1)
Course curricula of the extra certifications should be uniform for all the centers which provide the clinical pharmacology teaching programs	Agree	30 (78.9)	41 (68.3)
	Neutral	4 (10.5)	14 (23.3)
	Disagree	4 (10.5)	5 (8.3)
Curricula of additional clinical pharmacology courses should be included in the course curriculum of PG pharmacology teaching programs	Agree	31 (81.6)	49 (81.7)
	Neutral	4 (10.5)	8 (13.3)
	Disagree	3 (7.9)	3 (5.0)
Responses given to the question regarding the situations where clinical pharmacologists play a significant role	Academia	36 (94.7)	55 (91.7)
	Pharmaceutical organizations	38 (100.0)	59 (98.3)
	Government regulatory bodies	36 (94.7)	56 (93.3)
	Hospitals	34 (89.5)	56 (93.3)
	All	31 (81.6)	51 (85.0)
Responses given to the question regarding clinical pharmacologists' roles in a hospital	OPD consultation	25 (65.8)	36 (60.0)
	Ethics committee consultation	34 (89.5)	54 (90.0)
	Clinical trial designing	32 (84.2)	58 (96.7)
	Clinical trial auditing & inspection	34 (89.5)	55 (91.7)
	Pharmacovigilance	35 (92.1)	53 (88.3)
	Prescription audit	36 (94.7)	56 (93.3)
	Therapeutic drug monitoring	36 (94.7)	58 (96.7)
	All	21 (55.3)	30 (50)
Responses given to the question regarding how to increase the awareness of clinical pharmacology?	Increased awareness among other specialties by healthy collaborations, organizing workshops and conferences	38 (100.0)	55 (91.7)
	Organizing clinical pharmacology outpatient clinics in specialty hospitals	30 (78.9)	40 (66.7)
	Increasing awareness among the government representatives, medical councils to create posts and a career path for clinical pharmacologists	31 (81.6)	48 (80)
	Special courses for aspiring students in government and private institutes	21 (55.3)	31 (51.7)
	Student exchange/training programs with the universities in overseas for doctoral or research fellowship studies	24 (63.2)	41 (68.3)
	Provide evidence to the hospital management of the cases managed by clinical pharmacologists	29 (76.3)	42 (70)
	All	14 (36.8)	18 (30.0)

CP clinical pharmacologist, DM doctorate of medicine, MD doctor of medicine, OPD outpatient department, PG postgraduation

a separate clinical discipline would benefit the patients [13]. They opined that the importance of training in CPT should be stressed, and CPs should be part of the rational prescribing in

primary care. J. C. Mucklow also suggested that CPT training is essential and opined that organizing problem-based learning and practical training to develop prescribing skills

Table 3 Responses based on the qualification of the clinical pharmacologists

Characteristics concerning qualifications		MD CPs (%)	DM CPs (%)	Others (%)
Place of work	Academic institution	17 (28.8)	12 (35.3)	1 (20.0)
	Hospital	12 (20.3)	11 (32.4)	3 (60.0)
	Pharmaceutical company	30 (50.8)	10 (29.4)	1 (20.0)
	Drug regulator	0 (0.0)	1 (2.9)	0 (0.0)
Clinical pharmacology training sufficient in the course curriculum of PG	Agree	7 (11.9)	5 (14.7)	3 (60.0)
	Neutral	9 (15.3)	6 (17.6)	0 (0.0)
	Disagree	43 (72.9)	23 (67.6)	2 (40.0)
Advantageous to have a certificate course in clinical pharmacology	Agree	34 (57.6)	12 (35.3)	3 (60.0)
	Neutral	8 (13.6)	8 (23.5)	1 (20.0)
	Disagree	17 (28.8)	14 (41.2)	1 (20.0)
Any certifications other than those related to clinical pharmacology	Yes	35 (59.3)	16 (47.1)	4 (20.0)
	No	24 (40.7)	18 (52.9)	1 (80.0)
Have certifications other than those related to clinical pharmacology ($n=52$)	Certification is beneficial to career growth	28 (80.0)	15 (93.8)	1 (100)
	Certification is not beneficial to career growth	7 (20.0)	1 (6.2)	0 (0.0)
Have certifications other than those related to clinical pharmacology ($n=52$)	Certification offered by private organizations	24 (68.6)	10 (62.5)	1 (100)
	Certification offered by government organizations	11 (31.4)	6 (37.5)	0 (0)
Course curricula of the extra certifications should be uniform for all the centers which provide the clinical pharmacology teaching programs	Agree	45 (76.3)	23 (67.6)	3 (60.0)
	Neutral	7 (11.9)	10 (29.4)	1 (20.0)
	Disagree	7 (11.9)	1 (2.9)	1 (20.0)
Curricula of additional clinical pharmacology courses should be included in the course curriculum of PG pharmacology teaching programs	Agree	50 (84.7)	25 (73.5)	5 (100.0)
	Neutral	6 (10.2)	6 (17.6)	0 (0.0)
	Disagree	3 (5.1)	3 (8.8)	0 (0.0)
Situations where clinical pharmacologists play a major role	Academia	53 (89.8)	33 (97.1)	5 (100)
	Pharmaceutical organizations	59 (100.0)	33 (97.1)	5 (100)
	Government regulatory bodies	53 (89.8)	34 (100)	5 (100)
	Hospitals	51 (86.4)	34 (100)	5 (100)
	All	45 (76.3)	32 (94.1)	5 (100.0)
What roles in your opinion do clinical pharmacologists play in a hospital?	OPD consultation	32 (54.2)	26 (76.5)	3 (60.0)
	Ethics committee consultation	52 (88.1)	32 (94.1)	4 (80.0)
	Clinical trial designing	54 (91.5)	33 (97.1)	3 (60.0)
	Clinical trial auditing & inspection	52 (88.1)	33 (97.1)	4 (80.0)
	Pharmacovigilance	52 (88.1)	31 (91.2)	5 (100.0)
	Prescription audit	57 (96.6)	30 (88.2)	5 (100.0)
	Therapeutic drug monitoring	56 (94.9)	33 (97.1)	5 (100.0)
How to increase the awareness of clinical pharmacology?	All	27 (45.8)	21 (61.8)	3 (60.0)
	Increased awareness among other specialties by healthy collaborations, organizing workshops and conferences	54 (91.5)	34 (100.0)	5 (100.0)
	Organizing clinical pharmacology outpatient clinics in specialty hospitals	43 (72.9)	23 (67.6)	4 (80.0)
	Increasing awareness among the government representatives, medical councils to create posts and a career path for clinical pharmacologists	47 (79.7)	31 (91.2)	1 (20.0)
	Special courses for aspiring students in government and private institutes	31 (52.5)	18 (52.9)	3 (60.0)
	Student exchange/training programs with the universities in the overseas for doctoral or research fellowship studies	40 (67.8)	23 (67.6)	2 (40.0)
	Provide evidence to the hospital management of the cases managed by clinical pharmacologists	37 (62.7)	29 (85.3)	5 (100.0)
	All	20 (33.9)	12 (35.3)	0 (0)

CP clinical pharmacist, DM doctorate of medicine, MD doctor of medicine, OPD outpatient department, PG postgraduation

and seminars and workshops will significantly impact training in CPT [14].

Clinical pharmacologists' support is required to efficiently manage vulnerable populations like pediatric, geriatric, and pregnant women, susceptible to polypharmacy and drug-drug interactions. Elderly patients have decreased functional reserves, which made the American Geriatrics Society Expert Panel on the Care of Older Adults with Multimorbidity suggest that the clinical pharmacologist's role in patient management in a hospital is vital [15].

The results of our study concur with those of Avinash Arivazhahan from India in that a trained CP could play a multidisciplinary role in conducting research activities such as being part of the scientific/ethics review committees and running the clinical trial units in addition to patient-related services such as the pharmacovigilance programs, therapeutic drug monitoring, and drug information services, among others [16]. Avinash Arivazhahan also opined that the medical pharmacology postgraduate course falls short of what CP requires to play diverse roles in the pharmaceutical industry. For those who want to work in the pharmaceutical industry after graduation, observership programs should be made available.

Kazeem A. Oshikoya from Nigeria found that medical students and interns received inadequate CPT teaching in Nigeria. They also stated that both theoretical and practical CPT instruction should cover the concepts of rational prescribing, child medication dosage calculations, and pharmacovigilance [17].

COVID-19 pandemic has made most of the clinical research training online, and no practical training was organized during

the pandemic in India. Furthermore, various certifications and diploma courses in clinical research are being introduced by multiple institutions. Experts' opinions from our survey suggest that these courses have to be uniform, and the training has to be taken up by the experts in the field of clinical trials.

Training from the drug regulatory bodies must be imparted to the aspirants of clinical pharmacology. Training programs offered by institutes in clinical pharmacology, clinical research should provide skills and competency that meet the needs of society and contribute to public health (Table 2) [18]. Drug regulatory bodies should regularly organize workshops and conferences to sensitize medical graduates and pharmacologists about the importance of CPs. Corporate training institutes should be accredited for clinical research/clinical pharmacology training. The training should be provided by experts in clinical research. CPs should be given practical exposure to handling clinical trials and hospital patient management.

We have tabulated the issues that our survey identified and possible solutions for the same in Table 4. In our institute, we did initiate a clinical pharmacology training course, "Fellowship in Oncotherapeutics," with one aspirant in clinical pharmacology having an annual take-up. The student will be trained in clinical research, pharmacokinetics, pharmacometrics, pharmacovigilance, and responding to queries raised by clinicians. After completing the fellowship, they should be able to find jobs in their area of interest in industry or academia, where they will in turn provide quality education to the young aspirants. So, we suggest other institutes should also initiate similar training for the aspirants.

Table 4 Problems identified during the survey and possible solutions

Issues identified	Possible solutions
The scope of applied pharmacology is not adequately explained during postgraduation	Optimizing and framing of syllabus considering the prospects of CP
Inadequate training in postgraduation	Experts in CP should provide training to the aspirants Organizing workshops/conferences in clinical pharmacology Providing industrial experience/observership to postgraduates
Institutes lacking proper infrastructure are providing certification in clinical pharmacology/clinical research	<ul style="list-style-type: none"> • To raise the standards of the institutes to the level of accreditation by the CDSCO • Govt. bodies like ICMR should come forward to offer courses in clinical research
Lack of awareness about clinical pharmacology in the medical sector	<ul style="list-style-type: none"> • Increased awareness among other specialties by beneficial collaborations, organizing workshops, and conferences • Organizing clinical pharmacology outpatient clinics in multi-specialty hospitals • Increasing awareness among the government representatives and medical councils to create positions and a career path for clinical pharmacologists • Offering courses for aspiring students in government and private institutes • Student exchange/training programs with universities overseas for doctoral or research fellowship studies • Provide evidence to the hospital management of the cases managed by clinical pharmacologists

CDSCO Central Drugs standard control organization, CP clinical pharmacologist, ICMR Indian Council for Medical Research

Conclusion

Clinical pharmacologists play a multidisciplinary role in health care. Incorporating clinical pharmacology training during the postgraduation course in pharmacology is necessary to cope with the increased demand for trained clinical pharmacologists.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s00228-022-03409-9>.

Author contribution M. N. and D. V. are involved in the study concept, design and data collection. M. N., A. P., and S. H. were involved in data analysis and manuscript writing. M. N. was involved in the overall study conduct. M. N., D. V., A. P., and S. H. have reviewed the manuscript. M. N. and A. P. have addressed the reviewers' comments.

Data availability All the required data about the study are present in the manuscript. We are happy to provide additional data if the reviewer or the editor requires further data.

Declarations

Ethical approval Institutional Ethics Committee III of our institute has approved the study.

Consent to participate All the participants provided consent to participate in the study.

Consent to publish All the authors give consent for publishing the manuscript in the European Journal of Clinical Pharmacology.

Competing interests The authors declare no competing interests.

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