


Status of Research and Development Within Dental Institutes of Pakistan

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Abstract

Health sector institutes of Pakistan can play a pivotal part in improving the status of health sciences. This can be achieved by facilitating research and innovation facilities. It is a need of the day to emphasize academicians and institutional administrations to take keen interest in this regard. Knowledge of the present research and development conditions within higher education institutions may help in policy development and fund allocations at the required levels. Therefore, the objective of this study is to evaluate the status of research and development within dental Institutes of Pakistan. A 30 itemed questionnaire was e mailed/ posted to all institutional heads of all registered and recognized dental institutes of Pakistan. Response rate was 62% showing lack of administrative interest. Insufficient infrastructure, inadequate research planning, execution and intellectual property management was recorded. It can be concluded that higher education dental institutions of Pakistan are in need of deeper administrative and educational input to gear up the progress of health sector in this direction.

Keywords

research, policy, organization and administration, education

Highlights

- There is a lack of knowledge of status of research and development within higher education dental institutions of Pakistan. The implication of research has progressively been acknowledged in the dental academic circles. The traditions of Pakistan dental institutions is steadily transforming. This development is gradual but it's proceeding and it's possible to earn encouraging influence in future.
- This study has identified those areas within higher education dental institutes, which are in need of improvement of research and development. This will help in development of appropriate strategies to improve the quality of research within dental institutes.
- Research output evaluation, helps in appropriate policy development and resource allocation in future. A comparison of the past and present institutional

capabilities, financial stability and productivism will convince investors to empower a specific region.

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Introduction

Research is a systematic process to achieve new knowledge, science or invention by the use of scientific methods.¹ It promotes critical thinking, reasoning and rational decision making among the researchers.^{1,2} It can prove beneficial to the public in terms of social, economic and environmental level.

Health research has a deep impact on the prevention, diagnosis, treatment of diseases and especially on health care programs policy.³ Awareness of health care workers of ongoing researches in their respective fields can contribute massively in timely treatment provision.⁴ However, this mandates a sound educational base and a good source of best evidence to support their treatment recommendations.⁵ Health care providers can improve their knowledge and become a lifelong learner.⁶

The capital power gained through research work along with the knowledge acquisition and development potential can reform a country's economic status. Businessmen can play a critical role in promotion of a country to a superior level. Mass generation of research based projects can allow sufficient employment and improve the industrial stature. Thus, in the present era of industrial revolution, economic growth of a country relies upon scientific research, engineering solutions and innovation. It is important to bring scientific research to human benefit. Therefore, scientific progress of any country can be observed through extent of research within their scientific communities.⁷

Quality research work requires a healthy research environment. Higher educational institutes can play a pivotal role in this regard. They can implement innovative strategies, approaches, and programs to address research infrastructure, faculty/mentor shortages, access to medical and dental journals, allocated time for research and research scholarships for faculty as well as students. In addition, a positive attitude of a researcher towards undertaking and carrying out research, cannot be overemphasized. A memento of constant exploration can be achieved while keeping the educational standards abreast with the prevalent global pace. Lack of satisfactory knowledge, skill required for conducting research was reported by local post graduate residents.⁸ Mandatory undergraduate research training as part of the curriculum can improve their approach. Universities with virtuous research profile can influence the thinking its undergraduate students.⁹

The liaison of industrial community with the institutional researchers would also obtain the planned objectives. "Office of Research, Innovation and Commercialization (ORICs)" or "Research and Development (R&D)" within institutes, can provide strategic and operational support to the research activities of a university. It can play a central role in facilitating the outcome of university's researches. Higher Education Commission of Pakistan is working to establish ORICs through financial and management empowerment. Its main objective is to enfold all research activities including

commercialization. Insufficient attention to research by administrative bodies may lead to lag in scientific knowledge, within the national and international communities.⁷

27% of the total health researchers in the world are located in developing countries and only 1.2% of the annual health research is attributable to South Asia.¹⁰ Pakistan's contribution to world research publications has increased from 916 in 1996 to 24 504 in 2019 but still account less than .04% including the publications related to health sciences.¹¹ Therefore, the status of research within Pakistan at the present time needs to be upgraded to join pace with the progressive research culture across the globe. The output of research from an institution can be assessed to evaluate the "effective research" produced so far. Research effectiveness closes the gap in between the affected people and the people defining the problems and sorting their solutions by it.¹² Research output evaluation, helps in appropriate policy development and resource allocation in future. A comparison of the past and present institutional capabilities, financial stability and productivism will convince investors to empower a specific region.¹³ There is a lack of knowledge of status of research and development within higher education dental institutions of Pakistan. The rationale of this study is to identify those areas within higher education dental institutes, which are in need of improvement of research and development. This will help in development of appropriate strategies to improve the quality of research within Pakistan. The objective of this study is to evaluate the status of research and development within dental Institutes of Pakistan.

Methodology

This cross-sectional study using a voluntarily filled validated questionnaire was distributed to all Pakistan recognized 43 dental institutes in the year of 2020 of Pakistan. The census sample collection took 4 months. Any dental Institutes of Pakistan not registered or derecognized by Pakistan Medical Council and/or Higher Education Commission of Pakistan were excluded. Ethical approval was taken from the Institutional Review board. The questionnaire was made in English language devised according to the local and international¹⁴ guidelines for ORIC/Research and Development department¹⁵ and sent to the administrative head of all dental colleges via an email or postage. The questionnaire (Table 1) contained a total of 30 items. First nine questions inquired about the settings, recognition and level of academic courses. Remaining questions focused on presence of department of Research and Development/Office of Research, Innovation and Commercialization, its infrastructure, research facilities, institutional research/innovation protocol, Institutional Ethical Review Board, availability of research grants,¹⁴ Research output in form of individual publications, institutional journal publication, conferences/seminars/workshops, patent registrations, institutional intellectual portfolio, liaisons with technology centers, and commercial

Table 1. Scoring Criteria for Maximum Scores for Evaluation of Status of Research and Development.

Questions	Score
1. Courses offered	—
2. Location of institute	—
3. Status of institute	—
4. Description of institute	—
5. Registration of institute with PMC	—
6. Recognition of institute with HEC	—
7. Institute is established since	—
8. Undergraduate programs offered	—
9. Postgraduate programs offered	—
10. Office of Research and Development (R&D)/ORIC	1
11. R&D/ORIC established since	—
12. HR members working for R&D/ORIC	8
13. R&D/ORIC infrastructure facilities	7
14. R&D/ORIC meetings schedule	2
15. Research submission protocol	1
16. Research submission protocol communicated to all faculty members	1
17. R&D/ORIC funding/research grant	1
18. Institutional PMC/HEC indexed journal	5
19. IRB/ERC of institute	1
20. IRB/ERC members	9
21. R&D/ORIC innovation domain	1
22. Innovation domain components	2
23. Responsibilities of academic domain fulfilled	4
24. Responsibilities of patent/industrial domain fulfilled	3
25. Faculty member of your institute claim for patent at national or international level	3
26. R&D/ORIC institutional intellectual portfolio displayed on website	1
27. R&D/ORIC collaboration with technology, support and innovation center of HEC of Pakistan	1
28. Responsibilities of commercialization domain fulfilled	5
29. Institutional average number of publications	5
30. In house PhD scholars' numbers	5
Total score	66

Note. IRB = Institutional Review Board; ERC = ethical review committee; ORIC = Office of Research, Innovation and Commercialization; R&D = Research and Development; HEC = Higher Education Commission; PMC = Pakistan Medical Commission.

liaisons with investors. Maximum score obtained by answering each question is as follows. A total maximum score for each question is equal to 66. (Table 1).

As per HEC recommendations, R&D/ORIC is supported by infrastructure, financial and communication resources.¹⁶ A maximum score of nine was specified for HR members team to equally emphasize the importance of all team members i.e., Director ORIC with assistance from marketing person, administration person, finance persons, research associates, assistants and support staff. ORIC by design is a dynamic, outreaching and interactive office to inspire faculty and students for industry and community needed research.¹⁶ In terms of infrastructure and seating arrangements, ORICs consists of meeting room, free working space, open environment, transport facility and operational budget. So, R&D/ORIC infrastructure facilities were given a score value of 7.

HEC/PMC indexed journals plays a pivotal role in transition to a more transparent, rigorous, and focused system for

accreditation and monitoring the quality of national research journals. Its main objective is to bring academic and publication quality of the journals as par with international standards. Therefore, an indexed journal depicts the significance of quality research for an institute. So, it was given a score value of 5.

Existence of An Institutional Review Board (IRB) in an institute implies ethical research approach and practices. IRB team consists of chairperson, secretary, biostatistician, pharmacologist, clinical expert, legal adviser, religious scholar and a community representative. IRB members must have the professional experience to provide appropriate scientific and ethical review.¹⁶ Presence of an IRB and its constituent team members was given a weightage of nine.

Academic engagement is varied and includes collaborative research, contract research, consulting and other forms of knowledge exchange in the forms of workshops and conferences.¹⁷ Innovation domain of institutional ORIC can

improvise academic activities such as conferences, workshops, newsletters and postgraduate programs to improve portfolio of the respective institute. Institutional ORICs displaying such potential were given a maximum score of 4.

Commercialisation is considered a prime example for generating academic impact because it constitutes immediate, measurable market acceptance for outputs of academic research.¹⁷ It covers laboratory facilities, economic feasibility, pilot studies, data transfer agreements and generates revenue. To equally emphasize its all aspects, it was given a score value of 5.

The most commonly used measure of individual and departmental research productivity is the number of faculty publications in selected outlets such as academic journals.¹⁷ Number of publications were graded to a maximum score of 5, as per the reported annual number of publications. Number of in house PhD scholars or PhD supervisors can contribute as approximately one-third of all research outputs. This can strengthen the research quality to maximize a university's international standing.¹⁸ As per the number of PHDs, maximum score was graded as 5.

Cronbach's Alpha test was calculated as .86 form pilot study, to determine the internal reliability of the questionnaire. The total score gained for status evaluation was the variable of interest. The percentage score was graded as low ≤ 21.78 (33%), moderate ≤ 43.56 (66%) and high $\geq 44-66$.¹⁹

Factors effecting internal validity were identified and controlled. Lack of participation was controlled by giving a comprehensive description of the study though the email/WhatsApp request. Fear of Exposure and Penalization of participating institutions was addressed by a disclaimer about confidentiality, anonymity, purposeful and restricted use of the collected data. Incomplete forms were controlled by default as the software used²⁰ for questionnaire generation, did not allow submission unless the form is completely filled. Although teaching in all dental colleges is done in English language. However, to make sure that the study questionnaire had no language issues it was revalidated by Institutional Review Board. The questionnaire was revalidated by five senior members of faculty of different dental colleges, which included Professors and Associate professors to assess all items of the questionnaire on the basis of relevance, content, language and cultural acceptance. The questionnaire was adjusted as per their responses.

The data was entered in SPSS. The frequencies, percentages, mean, median and standard deviation were calculated for initial questions. T test was applied to compare the reasons for variations in scores for research and development. Significance of difference in responses was determined using *P*-value, which was considered statistically significant at $\leq .05$.

Results

The questionnaire was sent to the administrative heads of 43 dental institutes and 26 responded. As far as basic information is concerned, all of the institutes are registered with

Pakistan while 24 (92.3%) are recognized by HEC. Out of these 26, 17 (65.4%) are private and 9 (34.6%) are public sector institutes, 25 (96.2%) offer dental courses, 19 (73.1%) medical, and 16 (61.5%) offer courses in allied health sciences. There are 14 (53.8%) institutes offering the courses in all of these three domains; dental, medical, and allied health sciences and 11 (42.3%) offer all of the undergraduate programs i.e., MBBS, BDS, nursing and DPT. There are 8 such institutes who offer more than three postgraduate programs.

The interest of our study lies in the institutes where research and development department/cells are established and actively working. So, out of these 26 institutes who responded, 23 (88.5%) have such department/cell/office responsible for research, innovation, and commercialization. The frequency and percentages of the responses about setting and level of academic courses in these 23 institutes are given in [Table 2](#).

Only 3 (13%) institutes have high score, 14 (61%) have moderate, and 6 (26%) have low status of research and development. The distribution of the institutes with respect to the status of research and development is displayed in [Figure 1](#). Regarding the human resource members, director is present in ORIC/R&D in 18 (78.3%) institutes, marketing personnel in 6 (26.1%), administrative personnel in 12 (52.2%), financial personnel 5 (21.7%), intellectual property manager in only 3 (13%), publication officer in seven institutes (30.4%), research associate and supporting staff in 15 (65.2%) institutes only.

Regarding the infrastructure facilities ([Figure 2](#)), internet is the most provided facility by some institutes 20 (87%) followed by meeting room in 15 (65.2%) and physical working space in 11 (47.8%). Almost half of the institutes 13 (56.5%) schedule their meeting of ORIC/R&D after every two months, 7 (30.4%) once a month and 3 (13%) never arranged such meeting till the time they filled this questionnaire. It is worth noting that in institutes where ORIC/R&D is less than 5 years old, no meeting was ever held. All institutes have IRB/ethical review committee (ERC), 12 (52.2%) have their own journal, while 18 (78.3%) have institutional research/innovation proposal submission protocol, out of which 14 (77.8%) institutes officially communicate the information of submission protocol to all faculty members.

The details of members present in IRB/ERC are given in [Figure 3](#). Out of 26 institutes, 12 institutes contain innovation domain. Out of these 12, the component academic domain is present in 11, while the patent domain is present in seven institutes. The responsibilities fulfilled by academic domain, patent domain, and commercialization domain are elaborated in [Table 3](#). The number of institutes fulfilling the responsibilities of patent/industrial domain is not so encouraging. The number of institutes in which any faculty member claimed for national patent is 4 (17.4%) and for international patent is 3 (13%). The institutional intellectual portfolio (IIP) is established in 4 (17.4%) institutes only, while 12 (52.2%)

Table 2. Responses of Administrative Heads About Setting and Level of Academic Courses (n = 23).

Questionnaire Items	Frequency (f)	Percentage (%)
Courses offered		
Dental (yes)	22	95.7
Medical (yes)	17	73.9
Allied health sciences (yes)	14	60.9
Status		
Private sector	15	65.2
Public sector	8	34.8
Region		
Punjab	11	47.8
Sindh	3	13
KPK	8	34.8
Balochistan	1	4.3
Best description		
A university itself	6	26.1
An affiliated college	11	47.8
A constituent college	6	26.1
Institute established since		
<5 years	1	4.3
6-10 years	6	26.1
11-15 years	5	21.7
>15 years	11	47.8
Undergraduate programs offered		
MBBS (yes)	19	82.6
BDS (yes)	23	100
Nursing (yes)	12	52.2
Diploma in physical therapy (yes)	12	52.2
Postgraduate programs offered		
MSc (yes)	7	30.4
MDS (yes)	4	17.4
MPhil (yes)	8	34.8
MCPS (yes)	7	30.4
FCPS (yes)	19	82.6
PhD (yes)	7	30.4
Post doctorate (yes)	1	4.3
MPH (yes)	2	8.7
ORIC/R&D department		
present	23	88.5
ORIC/R&D department established since		
<5 years	17	73.9
6-10 years	5	21.7
11-15 years	1	4.3

collaborate with technology, support, and innovation center of HEC of Pakistan.

No significant variation in the institutional average number of publications (articles/book(s)/chapters/editorials) per year were noted. The average number of publications lies between 1-10 in 5 (21.7%) institutes, 10-20 in 6 (26.1%), 20-30, 30-40, and 40-50 in 4 (17.4%) institutes each. As far as the number of in house PhD scholars in the institute is concerned, there are 9 (39.1%) such institutes who do not have a single PhD scholar while 6 (26.1%) have 1-5, 2 have (6-10), 2 have (11-15), 2 have (16-20), and 2 have more than

20 in house PhD scholars. The overview of ORIC/R&D present in 23 institutes, is given in [Figure 4](#).

Discussion

Higher Education Commission of Pakistan is gradually strengthening Offices of Research, Innovation and Commercialization (ORICs) or "Research and Development (R&D) through financial and management empowerment. Its main objective is to enfold all research activities including commercialization. The rationale of conducting this study

was to identify those areas within higher educational institutes, which are in need of improvement of research and development through evaluating their status of research and development. This will help in development of appropriate strategies to improve the quality of research within a dental institute of Pakistan.

The survey form for this study was designed in three components of ORIC, mentioned in HEC guidelines.²⁰ The data was collected from Pakistan recognized dental institutes with a response rate was 62% approximately. It reflects the perspective of institutes regarding the importance of this subject.

The tremendous growth and development of healthcare sector demands pertinent rise in human resource status to meet strategic objectives and achieving competitive advantages in healthcare organizations.²¹ Human resource development is a central part of restructuring organizations, whether the aim is to develop organizational infrastructure,

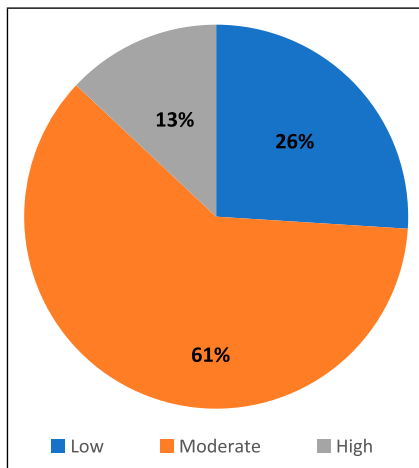


Figure 1. Status of research and development (n = 23).

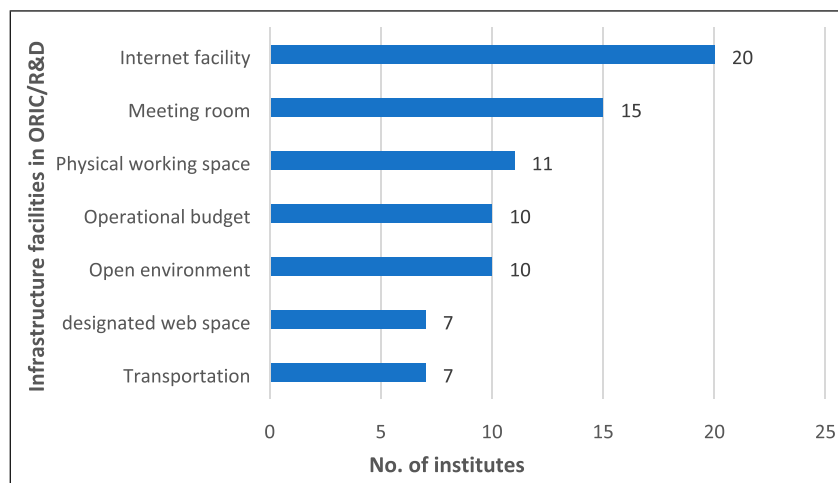


Figure 2. Infrastructure facilities in office of research, innovation and commercialization /research and development provided by the institute.

improve business processes, or increase knowledge, innovativeness or other organizational parameters.²² In present study, amongst the human resource members within ORIC/R&D, 18 (78.3%) institutes had directors, 12 (52.2%) had administrative personnel, 15 (65.2%) had research associates and supporting staff. However, only 6 (26.1%) had marketing personnel, 5 (21.7%) had financial personnel, 7 (30.4%) had publication officers and 3 (13%) had intellectual property managers. This reflects perception of institutional boards towards the research and development as effective HR in any department is the driving force through their strategic policies.²³ HR professionals have the technical proficiency to mold business growth and give organizations an edge over their competitors.²⁴

Institutional experimental research depends on infrastructure availability provided by universities or state-funded research institutes in the form of a well-equipped laboratory, well trained technical staff and university funding.²⁵ Research infrastructure is the underpinning foundation of a project-driven research system and requires long-term, sustained funding and capital investment to maintain scientific and technological expertise.²⁶

Present study shows (Figure 2) that 20 (87%) institutes provided internet on campus, 15 (65.2%) had meeting rooms and 11 (47.8%) had physical working space for research and development department. However, designated operational budget, web space and transportation are lacking, which is alarming as the availability of budget can affect working efficiency of whole unit. Research grants obtained through public or private resources can affect the extent of research.²⁴ Flexibility of evaluation criteria for approval of grants can facilitate diversity in research practices.²⁷ in addition, state funded or institutional research grants are likely to reduce potential problems for researchers in acquisition of pertinent equipment and continuity of approved research projects.²⁵

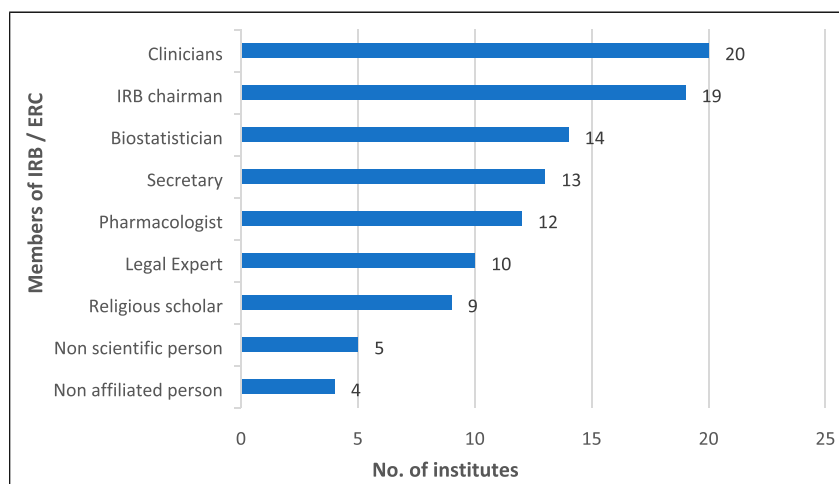


Figure 3. Members of institutional review board/ethical review committee present in an institute.

Table 3. Responsibilities of Respective Domain Fulfilled by the Institutes.

Domains/Responsibilities	Fulfilled by f (%)
Innovation (academic) domain (n = 12) ^a	
Conferences/symposiums/seminars	12 (100)
Workshop/training courses	11 (91.7)
Postgraduate program	7 (58.3)
Newsletter publications for information	6 (50)
Innovation (patent/industrial) domain (n = 12) ^a	
Liaison with patent attorneys	4 (33.3)
Funding provided to applicant (if required)	6 (50)
Generate innovative projects	8 (66.7)
Commercialization domain (n = 23)	
Lab testing/technical feasibility	11 (47.8)
Economic feasibility/funding support	6 (26.1)
Material and data transfer agreements	4 (17.4)
Pilot testing/commercial trials/consumer reports	8 (34.8)
Sale, licensing, earning	2 (8.7)

^aIt is the part of innovation domain that is present in 12 institutes only.

The results of present study depict that only 12 (52.2%) institutes offer funding support or obtain research grant, which demand a change in institutional research oriented strategic planning.

Innovations are the means to optimize the efficient and relevant use of available resources within in social-biological-economic systems.^{27,28} Principle role of ORIC is to facilitate the research of university mainly recasting the research into innovation (production processes and products) that will have a direct impact on welfare of community as a whole.²⁹ For sustainable growth, technological innovations must be managed from a holistic perspective, systemically and systematically.²⁸ Innovation can be sequentially staged as Generation, Incubation, Application and Evaluation. Each next step provides feedback of the preceding one with the final evaluation assessing initial Generation, thus completing the whole cycle²⁸

Present study reveals that only 52% of the institutes had innovation domain, thus reflecting a lack of opportunity for creativity for people working with highest intellect.

Commercialization of innovation results in economic logic of institutional investment and its financial return from the potential market.³⁰ Such modernist approach boasts institutional confidence and promises science-led economic growth and business opportunities. Although possibility of negative consequences always exist, but these can be amended with further deeper researches.³⁰ Commercialization of innovation leads to institutional-industrial collaborations.³¹ University–industry collaborations can result in institutional access to a broader pool of resources and knowledge at lower cost; it also offers a way to share the risks with partners.³¹ Emerging researchers appear to be increasingly requesting and accessing training in commercialization. This takes the form of workshops, federally organized funding opportunities, and

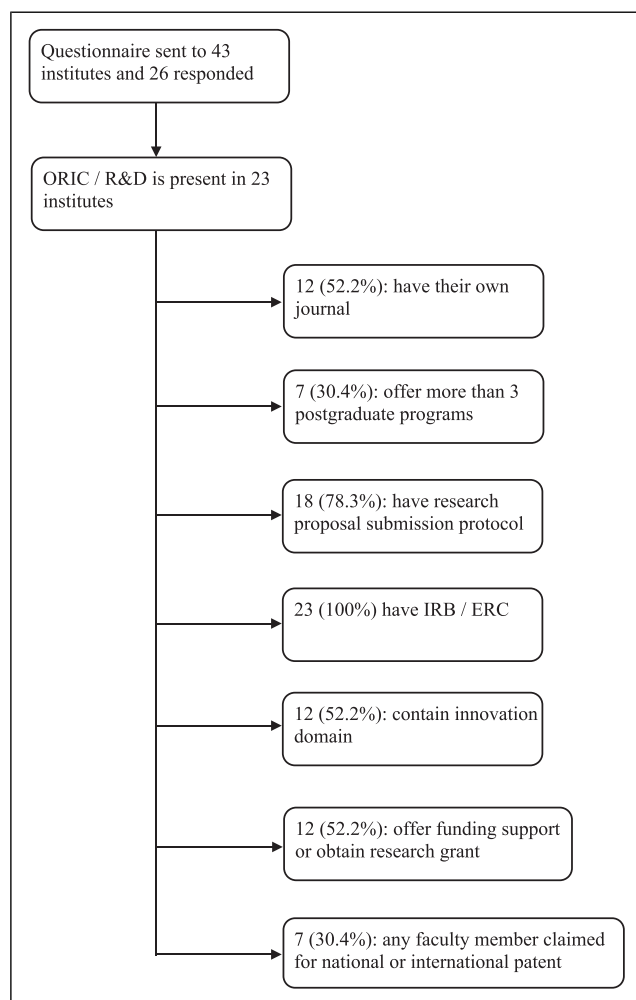


Figure 4. Overview of office of research, innovation and commercialization/research and development and some related aspects (n = 43).

graduate programs designed specifically to teach academic researchers about commercialization.¹⁹ Present study reveals that only 32% of institutions possess industrial domain thus reflecting a need to expand and collaborate in this direction. In addition, only 16% of institutions prioritized the display of intellectual property on their websites. Lack of relevant funds, delayed university approval processes, shortage of relevant skills and cultural gap in university-industry relationship are the barriers for timely technology transfer.³¹

Increase number of research publications with impact and high citation index reflect positive output of research activity.³² 28% of the institutes recorded 1-10 average number of publications per year, in this study, which needs keen consideration by the institutional administrations of all health sector institutes. Likewise, instances of research misconduct and abuse of research participants demand a need for institutional review boards or ethical review committees to safeguard the rights of study participants and the integrity of the research.³³ Ethical

board members are appointed with a sincere interest and a service requirement in addition to their academic responsibilities.³⁴ Few social members are also included to harmonize the research practices with social and cultural norms of the society. This ethical practice was reflected well in our study depicting 96% of the institutes contain IRB/ERC.

A major limitation to this study was the lack of response from 38% of total participants, which itself reflects the mindset of non-respondents' institutional administrations. It must be considered while perception of the research status of dental institutes within the country. A deeper insight of these records can be achieved through formal research and evaluation reports obtained through Higher education Commission with actual evidence of the intellectual property.

In light of this study, it is recommended that higher educational institutes must include research as part of undergraduate dental curriculum to mandate the institutional research facilitations and improve knowledge and skill of our dental professionals.

Conclusion

The status of research and development within higher education dental institutions of Pakistan is in need of greater administrative and educational input to gear up the progress of health sector in this direction. This can be achieved through inculcation of research and development policies, programs within dental undergraduate curriculum for their life long professional development and learning in this direction.

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Ethical Approval

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