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Communication barriers between basic scientists and clinicians in regenerative medicine: A qualitative study from Iran

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Abstract

Rationale, aims, and objectives: Cell-based therapeutics are among the latest advances in health care technologies. The rapid evolution of stem cell science in Iran has necessitated the application of scientific achievements in clinical settings. However, various issues hindered their translation, in particular, impediments in the interactions of basic stem cell scientists and clinicians. We highlighted the impediments in the interactions of stem cell scientists and physicians involved in the opinion of professionals from both groups.

Method: This qualitative research was conducted with thematic analysis, performed by purposive sampling. Thirty-two distinguished stem cell scientists and clinicians were interviewed to identify their perspectives on this matter. MAXQDA 2018 was used to classify the axial codes based on factors related to communications inefficiencies. The analysis of coded data recognized 18 subthemes and six major themes.

Results: Central themes include different registers of the two parties, counterproductive clusters hampered networking, external communication barriers, the competition to access resources, leadership conflicts, and the dissatisfaction of stakeholders with their share.

Conclusions: Most of the impediments were seemingly global, for example, the incoherent medical and basic science educational systems, the vulnerable career path of physician-scientists, and an increasing tendency towards overspecialization. However, some local specific issues were also described, for example, limited funding opportunities and the negative impacts of the division of medical education from the ministry of science, research, and technology in Iran. Proposed interventions include the reinforcement of physician-scientist programs, designing a distributed leadership model, and bringing back the scientific integrity to higher education in Iran.

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KEYWORDS
basic scientists, clinicians, communication barriers, regenerative medicine, translational science

1 | INTRODUCTION

Promoting public health by translating advancements in life sciences has always been a substantial challenge, particularly for innovative biomedical technologies, namely cell and gene therapies. Despite significant advances in medical sciences, there are increasing concerns about the slow rate at which these achievements are translated into safe and effective clinical treatments.[1] To ensure that optimum medical services are offered to people, health care authorities are required to facilitate the translation of scientific discoveries.

Basic biomedical science gives us an in-depth knowledge of fundamental biology and pathophysiology of diseases, which are essential for medical advancements.[2] Nevertheless, it needs massive investment with no guaranteed short-term outcome. That is why institutional authorities often neglect such programs in favour of the enthusiasm for early bird achievements.[3,4] Training basic scientists as the unique feeder of the translational science is likewise a costly program. Additionally, their career path is being hindered by several obstacles after graduation. Thus engaging basic scientists in translational research is of great importance.[5,6]

The potential of translational research, however, would be unattainable without the participation of physicians.[7] The scholarship suggested that daily clinical duties avert physicians from engagement into the research.[8-10] Although there is enough data on the willingness of physicians to take part in clinical trials under certain circumstances,[8,11-13] the number of clinicians involved in research has declined over the last two decades.[14,15] Even the clinician-scientist programs that were established to encourage clinicians to pursue research careers were not as successful as expected.[16] A variety of approaches still need to be taken to help physicians to become involved in research.[17]

Cell-based therapies have produced an increasing potential for remarkable treatments of intractable diseases that are currently unmet.[18,19] Despite promising preclinical findings, the long-term results of the registered clinical trials are not conclusive,[20] and the majority of cell-based clinical trials are usually discontinued at early phases.[18,21] Given its high value and bright perspective, it is also critical to facilitate product translation of cellular therapy.[18,22]

The concept of "valley of death" was initially used to describe hurdles to the translational success of basic biomedical scientific findings into human applications.[23] Later it became evident that there are at least two valleys of death: The first valley is where the biomedical technologies that proved to be efficient fail to reach the human trials. While the other valley usually makes clinical trials unable to obtain certification for clinical practice.[24]

A myriad of interlinked factors brings about the gap between stem cell discoveries and the available cellular therapies provided to patients.[25,26] One of the chief obstacles is difficulties in developing sustainable collaborations between basic scientists and clinicians.[27,28] In this qualitative study, we aimed to find out impediments in the interactions of basic stem cell scientists and clinicians involved in regenerative medicine in the opinion of academic and non-academic professionals from both groups.

2 | METHODS

This qualitative research was conducted with thematic analysis, performed by purposive sampling. Forty experts were invited, and 32 of them agreed to participate in this investigation. Of the 32 participants, 17 were basic scientists and 15 were clinicians. All attendants had a leading position in stem cell science or regenerative medicine practice with heterogeneous areas of expertise. Four out of seventeen basic scientists had medical backgrounds. Nineteen had academic positions, while 13 others were non-academics. Twenty-three were senior professionals, and nine were young investigators who got their Ph.D. in the last 7 years. Seventeen of our participants had senior administrative positions to lead both policy and disciplinary activities in their institutes. All but three people were Iranian.

Face-to-face interviews took place between November 2017 and August 2019. Two of the authors (HRB and AAR) conducted all the interviews to promote consistency. In-depth interviews, each took 1 to 2.5 hours, gave the interviewees enough room to raise their perspective on unforeseen topics. Twenty-nine of the interviews were conducted in Farsi and later were translated to English by the interviewers. The remaining three were conducted in English. The conversations continued until data saturation obtained. They were digitally recorded and subsequently transcribed by three of the investigators. The transcripts returned to the participants for correction. The principal investigator reviewed all transcripts and, together with the two other transcribers, coded the data preliminarily. MAXQDA 2018 was used to classify axial codes based on factors related to inefficiencies in communications between basic stem cell scientists and clinicians.

Trying to interpret the ideas of the interviewees, we analysed the codes in a group discussion with an iterative approach, consisting of basic researchers (ARB and MMM), medical doctors (HRB and RM), a sociologist (HB), a methodologist (MHM), and other authors (SM and AAR). Upon the content analysis, 18 subthemes and six major themes were identified and agreed upon that described the participants' opinions on the major drawbacks of translational medicine in Iran.

3 | RESULTS

The results suggested six dominant themes in response to the question of identifying impediments in the interactions of basic stem cell scientists and clinicians: (a) they did not share the same register; (b) the counterproductive clusters hampered grouping in the whole network; (c) external communication barriers deepened the gap between two parties; (d) the competition to access resources eliminated possible collaborations; (e) leadership conflicts prevented the creation of a cooperative team; and (f) none of the stakeholders were satisfied with their share.

3.1 | Theme 1: They did not share the same register

3.1.1 | Different training background

Although all participants belonged to the biomedical field with experience in stem cell research, they claimed they often were not able to understand each other. Some of them argued that their misunderstanding had its roots in their various training backgrounds. They suggested that they better take academic courses in the other field. An academic paediatrician mentioned: "In our country, a scholar is qualified either in basic or clinical sciences. They seldom studied both. I believe besides the reinforcement of the MD-PhD programs, researchers in either group should take a short/long academic course of the most important subjects of the other one."

Physician-scientist programs, which started about a century ago at the time that the Flexner report emphasized that scientific progress was essential for improved clinical care, aimed to train physicians who coupled clinical understanding with scientific vision. By definition, a physician-scientist is a medical graduate who performs biomedical research as his/her primary professional career. There was a general tendency in our interviewees for this approach to overcome communication barriers. A social medicine specialist pointed out: "Physician-scientist training program seems to be effective and must be developed in our country. However, clinical fellowship programs focused on cellular therapy for Ph.D. graduates should also be planned for."

3.1.2 | Diverse levels of clinical insight

By emphasizing on their varying degrees of clinical insight as a hurdle to their communication, some of our participants claimed that clinicians who directly faced patients and their high demand for new treatments were more comfortable to take innovative stem cell technologies into trials. On the contrary, basic scientists were more concerned with uncertainties in mechanisms of action in various types of stem cells. A clinical allergy specialist said, "Clinicians are often not aware of basic scientists' achievements which could play a major role in their field. On the other hand, basic scientists do not have a realistic perception of the patients' problems. The first step is creating a mutual understanding between them." From another point of view, an orthopaedic surgeon argued, "I have encountered a few substantial regenerative challenges but couldn't persuade colleagues in stem cell science to concentrate on it yet. It's apparent to me that they do not take my ideas seriously!"

A few basic researchers believed that a clinical perspective usually leads physicians towards a question with immediate relevance to human health and short-term plans. They considered it as a hurdle, although it was not a general agreement.

3.1.3 | Distinct cultural backgrounds

Different cultural behaviours often lead to miscommunications and team conflict. Our interviewees assumed that the two parties belonged to separate cultures. Their diverse cultural backgrounds were shaped because of the different environments in which they were educated. Experiencing different hierarchical systems in either managing systems was one item to which some participants referred. There was a consensus that in clinical environments compared with basic sciences' departments, a lower value was attributed to research.

There was a public agreement that creating shared cultural environments would be a solution. An academic neurologist said: "Looking back, I remember most of my collaborations with [stem cell] scientists originated from scientific meetings, where we mutually participated. I occasionally come back to my medical school classmates when I need to discuss something." Regarding the translational process, distant schools of thought in the two parties in terms of evaluating the significance of each stage was an underlying cause of some conflicts.

3.2 | Theme 2: Counterproductive clusters hampered grouping in the whole network

3.2.1 | Overspecialization and superabundance of subfields

Becoming an expert in a particular subject seems to be inevitable in today's academic life. According to some participants, the act of subdividing an existing specialty in biomedical sciences has increasingly been done in different biomedical and clinical departments in Iran. Once an academic clinician becomes established in a particular field, changing fields and conducting interdisciplinary research imposes a remarkable cost that results in a lack of mobility for most scientists. They claimed that by creating more subdivided departments, the scope of researchers' inter-group communications would reduce. Because each specialty needed to have subfields within the parent field, the problem began when these sub-specialties became social units that defined their norms. They raised the request that turning this sub-specialty into a new specialty was essential for its advancement.

Overspecialization in science has the immediate disadvantage for an individual that the chasm can be too deep to move to another field and that the benefits of field memberships were too high. As scientists specialize, they tend to give up their capability to evaluate the importance of other areas of science critically. Once scientists become dedicated to their unique field, monotony would appear as an obstacle in trans-disciplinary research. Isolation might have roots in overspecialization as it helped scientists and clinicians to acquire and sustain their career competitiveness. A dermatologist said, "Even in clinical sciences, we unnecessarily divided every discipline into many subfields. So networking even in a single discipline is a difficult task! We used to get along well with each other, at least in our department. I suppose personal interests were the main reason for what happened."

3.2.2 | Division of medical education from the Ministry of Science and Technology in Iran

Some participants who belonged to both parties referred to the division of two ministries, meaning the Ministry of Health and Medical Education (MoHME) and the Ministry of Science, Research, and Technology (MSRT) in Iran. The division happened in 1985. The participants believed that this division bitterly devastated the cooperative environment they once shared and negatively influenced their collaborations in biomedical fields afterwards. An academic molecular biotechnologist argued that "This communicational hurdle dramatically got worsen after the division of medical education from the Ministry of Science [Research] and Technology in Iran. There are few countries with the same condition. While the life sciences have entered a revolutionary era, we built a great wall between our scientists and physicians. Why should not our medical system get benefits from our biologists, IT specialists, chemists, and physicists?" Concerning the legislative role of MoHME, a basic academic immunologist mentioned, "The administrative regulation of cell therapy, recently released by MoHME, necessitates GMP-grade cell manufacturing facilities to be located in a hospital. It is not likewise in many countries. In my opinion, it is a new border wall drawn between two parties. I suppose stem cell scientists will be never let in!"

3.3 | Theme 3: External communication barriers deepened the gap in-between

3.3.1 | Different rules in legislation and supervision

Some of the interviewees who belonged to various disciplines pointed out that researchers set their career goals according to the regulations set by their institutions. Since such regulations vary substantially between the two approaches, it has deepened the gap in-between. An example could be existing asymmetrical reward systems. Many of the clinicians emphasized that their clinical duties seldom left them protected time to do research. Their request was for the authorities to interfere.

There were indeed different values regarding the speculated outcome of the two careers. One echoed item in the interviews was the concern for emphasizing the publication outcome. Some assumed that paying too much attention to publishing, especially when the number of papers count, harmed the commercialization rate for the funded projects.

The collaboration seemed to be unfair regarding legal and ethical issues. Some of the physicians who took part in this study ascertained that the legal burden of clinical trials was distributed unevenly with a larger share on their side. They believed that if a clinical trial failed, the physicians would be convicted by both regulatory bodies and patients in the lawsuit. A plastic surgeon said, "It is all about responsibility. Innovative treatment, especially clinical trials, are riskier than our routine practice. Furthermore, liability insurance companies usually do not cover them. It is unreasonable that the burden of probable failures falls only on the physicians' side."

3.3.2 | Media hype on cell-based therapies

Some participants assumed that the media flared up the argument by raising unrealistic expectations of stem cell therapy in society. The portrayal of regenerative medicine in media usually enticed people by their highly optimistic timelines of translation. Such discrepancies from the mass media to the people would directly be transferred to physicians. Clinical researchers and basic researchers as subsequent loops are indirectly affected.

3.4 | Theme 4: The competition to access resources eliminated possible collaborations

3.4.1 | Fragmented infrastructures

Physically fragmented infrastructures in clinics and research laboratories worsened the communication problems. There was no consensus among participants on where should good manufacturing practice (GMP) facilities are placed. Both parties had expected to own clean rooms in their workplace.

3.4.2 | Inadequate resources

Although Iran has an excellent reputation in stem cell science, some experts believed that government investments did not match even with neighbouring countries. It is getting even worse while considering the funds paid to the translation process. A cardiologist told us, "There are numerous advanced labs and modern clinics in Mashhad [the second-most-populous city in Iran]. Nevertheless, we do not have facilities for large animal models and clinical-grade clean rooms. I assume that if adequate financial resources could be allocated to the translational process, it would facilitate communication between the two parties."

3.5 | Theme 5: Leadership conflicts prevented the creation of a cooperative team

Underestimating each other's significance, both parties considered themselves as the best candidate to serve as the principal investigator (PI). Basic scientists found themselves settled at the upstream of translational medicine, which gave them the best position to administer the whole process. An academic cell and molecular biologist said, "To conduct such an elaborate process, one should know the basics of the proposed therapy and details of the pathophysiology of a condition. Basic scientists are aware of the capability of different kinds of stem cells and how they are expected to work in vivo. Who else can design an effective study to cover basic and translational? Indeed, we need grouping with several experts to make a functional result."

Clinicians usually seek the shortest path to practice clinical implementation, while basic scientists believe fundamental biomedical research is essential to fuel the translational pipeline. The interviewed clinicians raised the issue of a bidirectional pathway from the laboratory to the clinic and the importance of mutual exchange administered by the clinics. Consequently, clinicians considered themselves the best candidate to serve as the PI. An academic cardiologist said, "The ultimate goal is improving the health condition of patients? We have no choice but to start from the end. One should have the most critical clinical dilemmas in mind to design and conduct a research project."

Despite differences in opinions, both sides agreed that a governing body needed to coordinate between multiple local leaders, and neither party should accept the responsibility. An academic biologist with a medical background said, "With no big picture in mind, neither basic scientists nor clinicians have the capability of leading the entire process."

3.6 | Theme 6: None of the stakeholders were satisfied with their share

3.6.1 | Different financial incomes

Different incomes in medical practices and running research projects influenced physicians' motivation to spend time in clinical research. Lack of time was a barrier in conducting clinical research, especially among young clinicians. There was disagreement on whether the provision of separate time for research would be the answer. An orthopaedic surgeon said, "…my last but not least conflict is reserving some time to take care of it [research]. While research is an important part of a basic scientist's job, I need to cancel some operations to take time to concentrate on [stem cell] projects. Eventually, sometimes I feel like being ignored."

On the other hand, some of the basic scientists interviewed thought that the unsatisfactory participation of clinicians was a disappointing barrier. An academic immunologist (MD/PhD) said, "They [the clinicians] always nag about the shortage of time. It sometimes takes me two or three weeks to arrange a meeting with a junior clinician. In the end, this is me or my postdoc associates who should take care of gathering the clinical data! I do not feel good about it."

3.6.2 | Inappropriate distribution of professional incentives

Despite the economic disincentives which tended to push medical students away from research and towards some clinical fields, there were still some medical graduates who consciously decided to pursue their careers as physician-scientists. According to the physician-scientists interviewed, there was a lack of anticipated career development for MD-PhD researchers. An academic biotechnologist (MD-PhD) said: "…after graduation from medical school, I decided to play a role at the cornerstone of translation. That is why I pursued my education in basic science. Now I feel I belong to neither of the groups! There is no defined position for a physician-scientist in our country [Iran]."

Some participants thought the solution was for the executive and legislative authorities to intervene. They believed a revision was needed in assessing their work and their share of intellectual properties. A dermatologist said, "Clinicians are always worried about the intellectual properties of research. It was their authority that attracted their patients to unknown treatment methods."

Overall, most of our interviewees concluded that each party played for higher stakes by ignoring the other's role. Both believed they did not have satisfactory rewards. An academic geneticist said: "An innovative kind of platform is required for communication. The current models do not work anymore. In such a network, both clinicians and basic researchers find the play fair enough to continue. The most annoying thing in the traditional way is that none of the players are satisfied with their share."

4 | DISCUSSION

During recent years, Iran has achieved considerable success in science and technology development.[29,30] Iran, additionally, was recognized as the frontrunner in terms of annual growth rate in scientific publication worldwide.[29,31] The emergence of stem cell science as a discipline in Iran dates back to the breakthrough findings of the Royan Institute, a leading stem cell research centre in the country, in 1999. Since then, stem cells and regenerative medicine have gained increasing attention, and public expectation of their clinical applications has been raised likewise all over the world.[32-34] However, the translation of basic and preclinical discoveries into efficient cell-based treatments faced many challenges, an example of which could be communication failure of basic scientists and clinicians.[30,35,36] This qualitative study explored the causes, many of which are aligned with similar investigations in other countries.

4.1 | Educational backgrounds

The literature showed that many physicians underscored the need to gain exposure to research and engage in it.[37,38] Many studies outlined various barriers that clinicians usually faced while engaging in research.[8,13,39,40] Our participants confirmed this, and some agreed with the literature that the gap had its origins in medical education.[41,42] Incorporating training and practicing research into institutional duties of clinicians might facilitate engaging in research; yet, education is a prerequisite.[43]

The integration of educating basic sciences and clinical years was proposed with different scenarios. Traditionally, when medical students complete basic courses, they start the clinical stage and enter clinics and educational hospitals.[44] Some participants thought this caused medical graduates to lose touch with basic sciences. Experiencing the clinical environment in the early years and adding basic courses into the internship period were appreciated by some experts.[45,46]

4.2 | Physician-scientists

By observing clinical challenges in devastating disorders, physician-scientists can raise research hypotheses, and on the other hand, they will be able to translate promising cell-based discoveries into tangible clinical and para-clinical services.[47] Without their intervention, many clinical observations are never shared with basic researchers and, therefore, are not incorporated into medical research. Consequently, patients' problems and complications will often be ignored.[48] By the pivotal role physician-scientists could play to orchestrate translation, they should be regarded as critical players in the health professional community, and their position needs to be reaffirmed within a broader professional hierarchy.[7,16,49-52] Many reports have depicted an increasing decline in physicians' enthusiasm to pursue path.[48-50,53] Although these endangered species, as famously articulated by James Wyngaarden in 1979, are continuing to thrive, their professional position is progressively encountering serious challenges.[50,51] Our participants argued that unlike the laboratory-based researchers, they could not dedicate the necessary time to technological advances and access equal expertise in laboratory sciences. As a result, they are not supported by grant bodies and their institutions. It is one of the reasons why many clinical trials fail to reach phases 3 or 4 and, consequently, never be administered to patients.

On the other hand, by losing their competitiveness, they cannot rely on delivering clinical care compared with pure clinicians. They concluded that unsustainable career paths would force these critical players of translational science to leave the field. Thus, the authorities require recognition of their contributions to the health system and invest in it. If the vulnerability of the physician-scientists in the current and ongoing academic standpoint continues, vertical integration of science and promoting human health through advancing science will not occur as expected.

As facilitators, physician-scientists are proposed to act as an intermediary negotiator between the two groups and constructively address the cultural divide. They may play a role in making the common language in one community understandable and meaningful to one another and assist them in achieving synergy and settling the discussion.[54] As physician-scientists can communicate more comfortably with a laboratory-based researcher on one side and collaborate with clinicians on the other side, they are considered as the best available candidates to play roles as facilitators.[49] Without their assistance, the pivotal role of physicians in identifying major clinical hurdles and raising them as potential cell-based therapies demand would be unfulfilled.

By exploring tensions between basic scientists and clinicians, our participants likewise recommended that physician-scientists could play decisive roles. They assumed that along with the international action plans and roadmaps, MoHME and other national funding agencies should take appropriate actions to support physician-scientist programs. The following recommendations are extracted from their points of view: Adoption of rigorous MD-PhDs programs, establishing a new program to involve physician-scientists in clinical practice, and balancing the existing funds to obtain a benefit for the career development of early stage physician-scientists.

4.3 | Division of medical education from MSRT

The foundation of the first formal health institution in Iran called "Sanitary Council" dates back to 1881.[55] Sanitary Council was the only significant public health authority until the establishment of the Ministry of Health and Charity Affairs in 1941.[56] After many ups and downs, in 1975, the Ministry of Health and Welfare was re-established.[57] What concerns our study was a particular event in 1986. All medical schools and research institutes were taken away from the MSRT and were integrated into the Ministry of Health, forming the MoHME.[58]

Gilavand et al reviewed nine national studies about the division of medical education from MSRT and the possibility of their reintegration. There were many disagreements regarding this separation. The study reported that providing a skilled health workforce was the advantage of this division. However, the quality of medical education and joint scientific disciplines were probably damaged. Most reviewed studies in Gilavand's work suggested that the reintegration of educational systems in the country was not possible even if desirable.[59]

This topic is still highly controversial in Iran, and the debate continues. Although most publications belong to the various authors with high-rank administrative roles in MoHME, they admitted that the dramatic improvement in the health care system in Iran could not necessarily be attributed to this division.[60] Given the difficulty of the reintegration of medical education into MSRT, some participants made the following recommendations: (a) Geographic proximity: Institutes with similar missions originated from MSRT and MoHME could be located at the same place, while they are administered separately. (b) Mutual grant bodies: Funding agencies with common research targets governing by the joint board. (c) Combined innovative centres, namely science parks with third-party management systems. (d) MSRT and MoHME should facilitate further education of their graduates in each other's disciplines.

4.4 | Overspecialization

In the early 19th century, the medical practice altered from a pre-scientific holistic approach to the modern paradigms supported by mechanistic explanations of pathophysiology. As a consequence, the desire of clinicians to further specialize arose. They found that specialization is a unique way to expand their expertise.[61] However, the World Health Organization (WHO) report in 2008 pointed out that fragmentation of care was one of the five obstacles health systems faced. Other studies revealed that the fragmented health care system in the United States accounted for one hundred million medical errors annually.[61-63]

The excessive specialization in science has already received criticism from well-known philosophers like György Lukács and Max Horkheimer. They argued that upon overspecialization, scientific researchers disregarded any broader examination of the social roots from their inquiry. Some later philosophers, including Jürgen Habermas, have also pointed out that overspecialization might lead to distorted relationships in society.[61,64] Habermas assumed specialization as an indispensable component of modern life. Nonetheless, he criticized the increasing autonomy of each social unit and considered it as a rupture of each of these cultural spheres.[65]

We asked our participants whether it would be possible to define the criteria for overspecialization and the limit to it. They thought that specialization was undeniable and beneficial, while the sub-sub-specialization was threatening. To find a limit to avoid over-specialization, we analysed the interviews. Our participants suggested that sub-specialization would be able to continue until the "social units" of a society exceed its capacity. Otherwise, the outcome would be fragmented academic departments, too narrow for a comprehensive view of patients and too rigid to adapt to the multi-disciplinary nature of modern medicine. Our participants also had concerns regarding overspecialization, which resulted in a disconnection between collateral sub-specialties.

Restifo and Phelan confirmed our findings that living in boundaries of different social units led to various dialects, each loaded with specific terminology and acronyms that bound everyone inside, while incomprehensible to outsiders. Furthermore, Restifo and Phelan claimed that members of each social unit gradually shared a value system, which is fundamentally different from other units. This situation happened when the cultural divide emerged, and the authorities need to prevent it.[66] The long-term effect of over-specialization has aggravated the gap between health care and medical research. Overspecialization caused divergence in the career paths and pulled apart the worlds of clinic and research.[67] Members of the divergent disciplines were organized into their groups, trying to shape their customs and enhance their boundaries.[68] Currie et al claimed that this was more likely to happen in clinical departments.[69] Without a shared perspective on a given problem, active knowledge exchange across the professional divide would not occur. Overspecialization has seemingly undermined the ultimate mission for patient care.[70]

TABLE 1 Summary of the vital administrative interventions proposed by the participants

1. Require medical students to get involved in learning and practicing research during medical school.
2. Encourage co-mentoring of PhD students and clinical fellowship trainees by advisors from basic science and clinical departments.
3. Provide postdoctoral programs for clinicians and clinical fellowships for PhD and MD-PhD graduates to enhance the quantity and quality of physician-scientists' workforce.
4. Strengthen the position of physician-scientists by redefining their career in clinics.
5. Prepare a "protected time" for academic physicians to research as a part of their mandatory activity.
6. Facilitate the self-made division between the two Iranian ministries (MSRT and MoHME) either by geographic proximity in research infrastructures or by some virtual structures to mobilize the interactions of faculties and students.
7. Develop an ethical, regulatory, and legal framework for regenerative medicine to address the duties and authorities of clinic and laboratory sectors.
8. Prevent the creation of "social units" in each subspecialty by strengthening the social ties in each discipline.
9. Facilitate small-group interactions between clinicians and basic scientists through mutual scientific programs or focus group discussions in conferences.
10. Design a distributed leadership model to terminate the competition for being a PI between basic scientists and clinicians.

4.5 | Leadership conflicts

The results showed that there was a rivalry between the two parties for leading the process. Person-centered management was not able to terminate this competition, as one party would take the lead, not tolerated by the other. Our participants suggested the Iranian authorities establish a distributed leadership model. The model assumed that several principal investigators should collaborate in such a research team. An inclusive leadership could then be rotated among various members. The literature confirmed distributed leadership as a flexible and effective model to tackle communication barriers.[71,72] Being involved in conducting the translation process could encourage collective responsibility.[73]

During our in-depth interviews, the participants made some recommendations to tackle communication barriers, which are summarized in Table 1.

5 | CONCLUSION

The widening gap between stem cell scientists and clinicians and an emphasis on overspecialization are global realities. Nevertheless, each country faces specific hurdles, depending on their cultural backgrounds and local regulations. This qualitative study addressed the communication obstacles between the two groups based on the views of (mostly) Iranian scholars active in the field of stem cells and regenerative medicine.

Our global concerns include the incoherent medical and basic science educational systems, the vulnerable career path of physician-scientists, and an increasing tendency towards overspecialization. Of note is Iranian scientists' achievements in stem cell research. However, we faced some specific issues: (a) limited funding opportunities, (b) local cultural barriers for collaborations across disciplines, and (c) the negative impacts of the division of medical education from MSRT.

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