Original Article

Perception and Recognition of Clinical Medical Physicist Roles and Responsibilities by Specialist Physician Staff: The First Mexican Survey

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Abstract

Introduction: Although medical physics as a profession is recognized as part of the health-care professional workforce by the International Labor Organization, in the Mexican context, the figure of the medical physicist (MP) is often inappropriately associated solely with technical work, leading to perception, recognition, and salary implications. The aim of this study was to explore the perception of medical specialists regarding the role and responsibilities of MPs in clinical practice in Mexico. **Methods:** A national survey was answered by medical personnel, ranging from residents to qualified specialists in November 2019. The questionnaire consisted of ten questions related to perception of MPs. The survey was open to all medical specialists regardless of their involvement in the use of ionizing radiations or otherwise. **Results:** It was shown that approximately two-thirds of specialists know and recognize the medical physics profession in hospitals and the roles and responsibilities of MPs. However, 19% of medical specialists considered the standard of service as inadequate. **Conclusion:** MPs must exert greater efforts to promote their status and enhance the recognition of their contribution to health care. The low level of recognition in diagnostic and interventional radiology and in nuclear medicine in Mexico might be related to nonexistent or unclear documentation and inadequate regulations, policies, or directives promoted by the health-care authorities.

Keywords: Medical physics, Mexico, profession, recognition, responsibilities, roles

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Introduction

The advent of medical physics in hospitals in Mexico is directly related to the arrival of radiotherapy (RT) devices in the country. In 1956, the first Co-60 equipment (Theratron Jr) was installed at the National Institute of Cardiology "Ignacio Chávez" and the first clinical physics department was created in the country.[1] According to the National Commission for Nuclear Safety and Safeguards (CNSNS) and García-Hernández *et al*.,[2] there are currently 106 centers licensed to practice teletherapy and 177 institutions licensed in nuclear medicine (NM) in Mexico. In addition, the Ministry of Health (SSA, its acronym in Spanish) reported that 55 centers use hybrid NM imaging equipment, with 71 devices in total in the country, 23 (42%) being in the public sector. In the case of diagnostic and interventional radiology (D and IR), the SSA reported that 793 computed tomography scanners, 1473 mammography units, 187 angiography units, and 316 magnetic resonance scanners operate in Mexico.[2]

The increase in the number of public and private institutions where diagnostic and treatment procedures involving ionizing and nonionizing radiation are performed comes with the necessity of incorporating corresponding highly trained human resources, in particular qualified clinical medical physicists (qCMP), a group of health-care professionals

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possessing postgraduate education at a master's or doctoral level in the area of medical physics (medical devices and the use of physical agents in medicine) and including a period of 6 months to 2 years of supervised clinical training in the RT, NM[3] and D and IR[4] areas. In addition, according to the American Association of Physicists in Medicine, the qCMP must meet the criteria established in its policy statement 1[5] and respect the code of ethics specified in its policy statement 24.[6]

Although medical physics as a profession is recognized as part of the health-care personnel workforce by the International Labor Organization,[7,8] in the Mexican context, the role of the medical physicist (MP) is frequently confused with that of the medical dosimetrist in RT,[7] and in worst case scenarios, MP roles, responsibilities, and involvement in health care are completely unknown. This work aims to show the present status of medical specialist perception regarding the MP's role, responsibilities, and competencies in Mexico.

Methods

A survey questionnaire was designed and developed in Google Forms App, which allowed the researchers to easily collect, register, and archive response data for further analysis and reporting of results. The questionnaire clearly stated that the answers would be used to understand the medical specialists' perceptions and opinions about MPs. None of the questions involved personal data. The anonymous survey was distributed to medical specialists through medical social media. The participants consisted of a wide spectrum of medical professionals, from resident doctors to specialists and from public and private institutes nationwide during the 1st week of November 2019. The questionnaire consisted of ten questions (yes/no, multiple choice, Likert scale, and open-ended). The survey was open to all medical specialists regardless of whether they were involved in radiation applications in medicine or otherwise. The questionnaire (in Spanish) can be consulted at the following link: https://forms.gle/pynbDpjrNZWm1vkc9. Table 1 summarizes the responses from the survey.

All data generated and analyzed during this study are included in this published article (and its supplementary information files).

Results

Considering the reported by Heinze-Martin *et al*.[9] in 2018, there was a total of 147,910 medical specialists in Mexico. Thus, considering a confidence level of 95%, with values p = q = 0.5 and a sampling error of 5%[10] meant that a representative sample size of 384 would be needed. The survey received 406 responses. Six were discarded either because the medical specialty was not specified or did not correspond to medical specialist staff. Therefore, the number of responses received can be considered representative of the national context.

The questions and responses are presented in Table 1.

The category "other" included specialists in gynecology and obstetrics, neurosurgery, clinical immunology, nephrology, pulmonology, genetics, endocrinology, infectiology, allergology, hospital quality management, general surgery, bariatric surgery, angiology, hematology, cardiology, endocrinology, ophthalmology, urology, and dermatology.

Further analysis was performed to categorize respondents by medical seniority (residents vs. qualified specialists) and

Table 1: Questions included in the survey and corresponding answers

Question	Answer (%)
1. What is your medical specialty?	Radiation oncology (31), neurosurgery (16.0), anesthesiology (7.8), radiology (7.3), resident (6.0), nuclear medicine (3.5), oncology (3.5), general medicine (3.0), internal medicine (2.8), neurology (2.3), pediatrics (1.5), psychiatry (1.3), orthopedics (1.3), pathology (1.0), other (12.0)
2. Are there any radiation devices available in your institution?	Yes (87.3), no (12.3), I do not know (0.4)
3. Are there any imaging devices at your institution?	Yes (97.3), no (2.3), I do not know (0.4)
4. Is there is a medical physicist at your hospital?	Yes (66.0), no (25.3), I do not know (8.7)
5. Do you know what medical physicists do in your hospital?	Yes (65.0), no (24.8), I do not know (10.2)
6. What are the areas in which medical physicists work in your hospital?	Radiotherapy (30.8), nuclear medicine, radiodiagnostic and radiotherapy (18.5), nuclear medicine and radiotherapy (13.8), radiodiagnostic (10.8), nuclear medicine (8.5), there are no medical physicists (7.0), radiotherapy and radiodiagnostic (4.5), nuclear medicine and radiodiagnostic (4.3), I do not know (1.8)
7. On a scale of 1 (irrelevant) to 5 (highly relevant) what opinion do you have about the relevance of their roles?	1 (3.7), 2 (3.0), 3 (8.0), 4 (12.8), 5 (72.5)
8. On a scale of 1 (poor) to 5 (excellent). What is your opinion on the quality of the service they provide?	1 (3.0), 2 (2.0), 3 (14.0), 4 (19.5), 5 (61.5)
9. Can you name any notable or high-impact contributions from the medical physics group at your hospital?	Quality control (25.6), research and innovation (19.0), radiological protection (16.5), incorporation of new technology (14.0), teaching (11.5), assistance on linac acquisition (9.9), management (3.5)
10. Add a comment about what medical physicists do in your hospital	Dosimetry (25.6), essential in service (22.6), quality assurance (20.7), brachytherapy (4.7), logistics (4.7), teamwork (4.7), biomedics (3.7), imaging (3.7), more medical physicists are needed (3.7), training (1.9), research (1.1)

whether the specialist was involved in the use of radiation or otherwise. Results are displayed in Table 2. The data on Table 2 were split into two sections. On the one hand, the second and third columns classified the total of responses between residents and qualified specialists (6% and 94%, respectively). On the other hand, the fourth and fifth columns showed the total of responses divided into the specialists that are (and not) involved with radiation tasks (42% and 52%, respectively). For each question (shown in rows), it is shown the most frequent answer in all cases and the percentage of each population that selects it.

Discussion

Although 41.8% of specialists that answered the survey belonged to medical specialties related to or familiar with RT and NM, the results showed that radiation equipment that is used for purposes of diagnosis or treatment is known by 87.3% of the total population, 66% of the specialists know about the presence of MPs and their roles and responsibilities, although the majority declared that such role is limited to RT and NM.

Medical specialists thought that the MP role is relevant (85.3% assigning a score of 4 or 5). Moreover, MPs provide a high-quality MP service (81.0% assigning a score of 4 and 5). However, regarding the quality of MP services, almost for the 19% of the answers, the values were between 1 to 3. We consider this high percentage an issue of concern since the opinion of medical staff is very relevant to the recognition of the profession. The profession needs to work harder to ensure that the quality of service is improved. We found that some functions of the MP are well acknowledged. This included patient-specific quality control, radiological protection of the medical staff and the patient, research, and innovation in current topics, and the incorporation of new technology, such as radiosurgery and tomotherapy. The main daily activities that specialists perceive as essential are dosimetry and quality assurance.

However, this really reflects a need for the promotion of the many other activities that MPs carry out. MP cooperation with medical staff in Mexico should not be limited only to the common routine tasks, but must be pitched at a higher level and include research aimed at improvement in patient service quality.

It is interesting to observe that the medical staff's opinion concerning the relevance of the MP roles, and the quality of the MP services did not appear to be related to the level of seniority of the medical professional, but simply to the area of specialization, radiation oncology being the medical specialty in which the MP is most recognized. This may be due to the long existence of Mexican regulations in radiation oncology services, in particular NOM-033-NUCL-2016, and its previous versions.[11]

The medical physics community in Mexico has to increase its efforts toward publicizing the additional contribution

Table 2: Results of the survey according to four categories of medical doctors

Question	Residents (%)	Qualified specialists (%)	Subgroup of qualified specialists involved in radiation (%)	Subgroup of qualified specialists not involved in radiation (%)
Percentage of the group within the total number of respondents	6.0	94.0	42.0	52.0
1. What is your medical specialty?	Residents (100)	Radiation oncology (33.1)	Radiation oncology (73.8)	Neurosurgery (30.9)
2. Are there any radiation devices available in your institution?	Yes (91.6)	Yes (87.2)	Yes (92.8)	Yes (76.3)
3. Are there any imaging devices at your institution?	Yes (95.8)	Yes (97.3)	Yes (97.6)	Yes (91.3)
4. Is there a medical physicist in your hospital?	Yes (54.1)	Yes (66.6)	Yes (88.6)	Yes (45.4)
5. Do you know what medical physicists do in your hospital?	Yes (45.8)	Yes (66.4)	Yes (88.6)	Yes (44.9)
6. What are the areas in which medical physicists work in your hospital?	Radiotherapy (25.0) Nuclear medicine (8.3) D and IR (16.4)	Radiotherapy (30.6) Nuclear medicine (6.35) D and IR (11.0)	Radiotherapy (39.2) Nuclear medicine (2.3) D and IR (4.6)	Radiotherapy (23.6) Nuclear medicine (12.5) D and IR (14.5)
7. On a scale of 1 (irrelevant) to 5 (highly relevant) what opinion do you have about the relevance of their roles?	5 (62.5)	5 (73.6)	5 (83.3)	5 (65.7)
8. On a scale of 1 (poor) to 5 (excellent). What is your opinion on the quality of the service they provide?	5 (58.3)	5 (62.1)	5 (69.6)	5 (56.0)
9. Can you name any notable or high-impact contributions from the medical physics group at your hospital?	Quality control (16.6)	Quality control (26.1)	Quality control (58.3)	Research and innovation (33.6)
10. Add a comment about what medical physicists do in your hospital	Dosimetry (16.6)	Dosimetry (26.1)	Dosimetry (58.3)	Essential in service (38.4)

D and IR: Diagnostic and interventional radiology

that qCMP can offer with respect to the patient management process.

We consider that, in the Mexican health-care system, the still immature consideration of the MP may be the result of the absence of clear guidelines and regulations.

The recognition of the professional title "MP" is a relatively recent development in Mexico, where the MP was simply known as "general physicist" for a long time. It was not until 2016 with the publication of the regulations NOM-033-NUCL-2016 regarding technical specifications for the operation of linear accelerators,[11] and NOM-040-NUCL-2016 regarding Radiation safety requirements for the practice of NM,[12] that the professional title "MP" was included in Mexican official regulations by the National Commission on Nuclear Safety (CNSNS). However, the education and training for the MP according to international recommendations[13-15] is still not well established until today. Moreover, in the current list of health-care professionals from the health-care department,[16] the title of MP code M01016 is still considered for professionals with education limited to a general physics or engineering degree and who have received practical training in the relevant clinical application area for 6 months.

As recommended by many international professional associations and the IAEA, a postgraduate degree in medical physics is required. This could be an MSc or equivalent degree of 1–3-year duration including courses covering all medical physics specialties and which is completed with a research report in one of the MP specialties. Another requisite for MPs is clinical training of not <2 years in one of the specialties of medical physics in the form of a structured residency program, supervised by a senior MP.

Unfortunately, the Mexican educational and health-care authorities have not yet developed a recognized structured academic and clinical program to accommodate today's competence needs in medical physics.

The present regulations regarding MPs and their roles and responsibilities in the Mexican health-care system do not permit neither promote active participation in quality committees, development of protocols, and working in multidisciplinary teams that include physicians, nurses, medical dosimetrists, technicians, engineers, and computer scientists. Examples of the advent of new technologies that would profit from deeper involvement of MPs include the integration of soft tissue imaging in radiation therapy delivery, advances in functional imaging of various forms, molecular targeted therapy, and nanotechnology for local enhancement of imaging and treatment delivery.[17] For this, it is essential to have MP higher education and training and has to have higher status.

The current conditions for medical physics in Mexico limits the possibilities for MPs to be able to adapt their education and skills to address complex new service needs in the medical field and patient interaction, as is expected elsewhere around the globe.[17-19]

Some of the internationally recognized competencies of the qCMP (in RT, NM, and D and IR) that need to be promoted in Mexico are as follows:[3,20,21]

- Optimize the use of radiation equipment and techniques so that unnecessary doses are as low as reasonably achievable in accordance with the objectives of the procedure's objective
- Manage the system, equipment, and components maintenance related to safety, preserving the original functional characteristics established by the manufacturer, according to the technical documentation
- Authorize the clinical use of equipment following rigorous acceptance testing
- Contribute at a managerial level to quality assurance in the institution
- Advise in the acquisition process and participate in the reception and acceptance of the equipment
- Provide compliance related data that is requested by personnel of the national regulatory authority
- Notify the hospital safety unit and radiation protection authorities immediately about the occurrence of events that affect, or may affect, the radiological protection of staff, patients, and the public
- Participate in investigating significant radiation incidents and accidents from the point of view of radiological protection
- Participate in the development, implementation, and training associated with new technologies
- Research and innovate on current issues related to the service
- Actively participate in protocols related to direct patient care, establishing direct and independent professional relationships, and communication with patients.

Nowadays, Mexican regulations include a written profile of MP as general physicist. In order to change it and make it more relating to the profession of MP and raise the status of MP, the following actions need to be done, and at the appropriate time, they should clearly be included in national guidelines and/or regulations:

1. Formal M. Sc. medical physics courses need to be established in more universities. The syllabus for this has to be at par with international courses
2. Professional association of MP should be promoted and supported
3. Regular workshops and conferences should be arranged, preferably sponsored, and supported by IAEA and other already established and recognized MP's organizations
4. Place MP in the hospital health-care staff and organization chart, since nowadays it remains unclear
5. The professional association representatives should appear before the regulators and relevant higher authorities/government to emphasize the superior role of MP including but not limited to the knowledge of effects of radiation on human body, planning on advanced modern planning system for complex techniques such as intensity

modulated techniques and radiosurgery, optimizations, etc. Apart from the quality assurance of advanced linear accelerators, imaging systems, to achieve precision therapy, diagnostics, research, and development in the area. It has to be clearly shown that MPs are much above the technician level and may be termed as scientific officers requiring higher status in the hierarchy and higher salary scale, preferably by law.

Conclusion

Considering the national Mexican context, these representative samples of medical specialists are aware of MPs, their importance in RT, NM, and D and IR services, and some of their functions. However, MPs need to make greater efforts, so that their roles may be fully acknowledged and be more visible. They also have to express to the authorities at all institutional administrative levels, with greater emphasis and clarity, the need for improving professional development structures, and opportunities in the interest of patient service. Joint activities with health care and medical organizations and societies must be developed to change the present unsatisfactory scenario revealed in this survey.

The development of enhanced vision and direction regarding the role of MPs by the health-care authorities is fundamental. Then, and only then, may the profession develop stronger and wider foundations.

Author contribution

Conceptualization: MHB, XRL, and JARL. Data curation: JARL. Formal analysis: MHB and JARL. Investigation: MHB. Methodology: MHB and JARL. Project administration: MHB. Supervision: JARL. Validation: MHB. Visualization: JARL. Writing original draft: JARL. Review editing: MHB, XRL, and JARL.

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Conflicts of interest

There are no conflicts of interest.

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