

Importance of Precision Medicine in Health Careers Training.

Mario Galindo¹[0000-0001-6184-0829], Mónica Ramirez²[009-008-9649-4143], Baltazar Jana³[0009-0009-6063-1422], Solange Soto⁴[0000-0002-9604-6462] y Valeria Sabaj¹[0009-0003-8968-9798]

¹ Programa de Biología Celular y Molecular, Instituto de Ciencias Biomédicas, Facultad de Medicina, Universidad de Chile, 8380453 Santiago, Chile

² Escuela de Enfermería, Facultad de Medicina, Universidad de Chile, 8380453 Santiago, Chile, Alumna 4^{to} año Carrera de Enfermería

³ Escuela de Medicina, Facultad de Medicina, Universidad de Chile, 8380453 Santiago, Chile, Alumno 3^{er} año Carrera de Medicina

⁴ Dirección de Pregrado, Facultad de Medicina, Universidad de Chile, 8380453 Santiago, Chile
mgalindo@uchile.cl

Abstract. Precision medicine (PM) is a new approach based on genomic data and the influence of environmental and lifestyle factors to generate patient-specific treatments. PM is based on the analysis of the genome to detect mutations in actionable genes and/or the application of specific pharmacogenetic tests, in order to generate specific treatments (personalized medicine), more effective, with less toxicity and safer, as opposed to conventional treatments aimed at the average patient. PM has been developed in the last two decades, mainly in the USA, Europe and recently in Asia. However, in several of these countries, PM is still in the implementation stage, both at the level of health care providers and health insurance companies. One of the most relevant challenges is to have trained professionals with specific training for the application of diagnostic tests, their interpretation and application in the design of specific treatments and for the follow-up and care of patients. This paper analyzes a series of quantitative and qualitative studies developed in the last decade, where the importance and relevance of the formal inclusion of the teaching of precision medicine in the curricula of health careers and for the training of practicing professionals is reflected.

Keywords: Precision medicine, Health careers, Curriculum

1 Introduction

Precision Medicine (PM) is a new paradigm in healthcare that uses information from a person's genome, environment and lifestyle to guide decisions related to their medical treatment, aiming to provide a more precise approach to the prevention, diagnosis and treatment of diseases (National Human Genome Research Institute, 2023a). The progress in the area of genomics shown in the last two decades has been fundamental to the development of PM. The study of the genome helps to understand how certain diseases arise (National Human Genome Research Institute, 2023b). In developed

countries, accreditation and education agencies have begun to include the teaching of PM in curricula and universities have begun to respond to this requirement. This poses a major challenge for our higher education system.

2 Theoretical Framework

The use of genomic information in health is increasingly frequent in certain parts of the world, such as the United States and some European countries (Giraldi Lavin et al., 2022), and has shown great and constant advances since the completion of the human genome project, which has opened a discussion regarding the academic preparation that health professionals should have in order to optimally deal with this innovation.

On the other hand, the report by The Economist Intelligence Unit "Personalized medicine in Latin America: Universalizing the promise of innovation" delves into the analysis of the progress of precision healthcare in Latin America, stating that healthcare professionals, from a general point of view, are not aware of the potential of this innovation, and that both doctors and nurses are not convinced of the personalization of medicine and are not aware of the potential of PM (The Economic Intelligence Unit, 2019). Although the document reports that Chile together with Mexico present important strengths, placing both countries in a stage of "strengthening the foundations" of precision health, it also mentions basic advances that have not been fulfilled in the national territory, for example, political leadership on the subject and a "genetic literacy" (The Economic Intelligence Unit, 2019; OECD Chile 2019).

The aim of this study was to identify entry barriers to the implementation of PM in developed countries, with emphasis on those related to knowledge of PM among health professionals.

3 Methods

A literature search was performed in PubMed using the words "Personalized Medicine Qualitative Survey" on May 28, 2023, resulting in 306 research articles published between 1997 and 2023. Of these 306 articles, two French-language articles were discarded. Of these 304 publications, 27 papers published in English were selected after reviewing the abstracts and in some cases additionally reviewing the publication in more detail. Finally, 10 publications were selected and analyzed that were published between 2012 and 2023 and that contain information regarding the knowledge and perception of the respondents regarding the usefulness and importance of PM and its application in the treatment of patients.

4 Results

The 10 publications selected include qualitative, quantitative or mixed methodology and correspond to surveys carried out on groups of between 28 and 1113 respondents who were mostly health personnel, although they also include health system users, patient groups, health insurance and coverage payers, expert groups and others, in different countries: USA, United Kingdom, Asia, Canada, South Korea, Italy, Kuwait (Table 1). The information was selected according to those publications that had questions or answers related to PM education.

Table 1. Selected publications

Year	Country	Study type	N° of respondents (% of respondents)	Type of respondents	Reference
2012	USA	Qualitative	51/67 (76%)	Treating Physicians, Health Insurance Company, Patient Association	Weldon et al., 2012
2013	Canada	Qualitative	28/28 (100%)	Health care stuff	Najafzadeh et al., 2013
2014	Canada	Qualitative	29/73 (40%)	Health care stuff	Miller et al., 2014
2018	Italy	Quantitative	1113/3670 (30%)	Health care stuff	Addis et al., 2018
2018	Kuwait	Quantitative	379/383 (99%) and 238/246 (97%)	Health care stuff (physicians and pharmacists)	Albassam et al., 2018
2020	United Kingdom	Mixed	67/233 (29%)	Health care stuff	Atutornu et al., 2020
2020	South Korea	Qualitative	53/53 (100%)	Health care stuff	Kim et al., 2020
2023	USA	Mixed	26/26 (100%)	Health care user	Stallings et al., 2023
2023	Italy	Qualitative	47/55 (85%)	Experts panel	Hoxhaj et al., 2023
2023	Poland	Qualitative	85/85 (100%)	Researchers, businessmen, policy advisors, project managers, physicians, public officials, lawyers, public health experts, health care administrators, biostatisticians, and others.	Stefanicka-Wojtas and Kurpas, 2023

In the reviewed works, the issue of PM education of both health professionals and users appears frequently relieved; lack of education is perceived as a major barrier to the implementation of this new approach (Albassam, 2018; Hoxhaj 2023; Stefanicka-Wojtas and Kurpas, 2023). The Addis (2018) survey of attendees at 5 congresses of different medical specialties revealed that almost all respondents (95.4%) are aware that the adoption of precision medicine will necessarily require changes in the education and training of healthcare professionals. Only 4.2% believe that no changes in professional training will be necessary. The study by Atutornu (2020) conducted among radiology professionals shows that almost one third of them (32.61%) state that teaching this approach is not their expertise and 13%, although interested, do not consider that they have the necessary skills. Moreover, the results of this study show that such is the lack of knowledge of these professionals that more than 20% (23.88%) are not sure whether or not they teach PM and another similar percentage (22.39%) wonder: what is PM; of those who say they do teach PM, most say they include it in the innovation or technology module (15.79%) or emerging modalities (13.16%) and no one says they teach it in the genetics module.

5 Discussion

Health care is undergoing an evolution from the traditional model involving a one-size-fits-all approach to a precision paradigm that considers the individual characteristics of each user of the health system. Therefore, the evolution of health care towards PM requires the contribution of new knowledge, a greater emphasis on the patient's perspective and genomic characteristics in care management, the development of new infrastructures and information management processes, and the transformation of health care delivery to ensure access to PM technologies.

Several authors have described the existence of multiple barriers to the advancement of PM that must be overcome. Among them, the education of both the patient and the various actors in the health care system stands out. Thus, it is clear that universities play a fundamental role both in undergraduate education and in the continuing education processes of health professionals. Thus, the approach of PM to university contexts is a pending issue that needs to be introduced in health careers.

6 Conclusions

In developed countries where the implementation of PM programs has already begun, there is still a lack of training in PM. In a more initial stage, of strengthening the foundations for PM, in which Chile finds itself, it is essential to begin to gather information on the educational needs in PM that will prepare health professionals for the implementation phase of PM.

7 Limitations and Future Research

PM is a topic that is becoming more relevant in the world. Thus, in Chile there is an opportunity to promote the incorporation of this knowledge in the training plans of health careers, considering that at the micro-curricular level there is no evidence on this subject. The limitations are: the lack of diagnosis and empirical evidence, as well as its current omission in the training plans of health careers. On the other hand, for our research group all this becomes an opportunity to gather information through a systematic research work aimed at determining what is the knowledge of PM in our students, academic staff and health professionals, through surveys to students and academics of health careers in Chilean universities and health professionals.

References

- Addis, A., Trotta, F., Tafuri, G., & De Fiore, L. (2018). Information needs on precision medicine: a survey of Italian health care professionals. *Annali dell'Istituto superiore di sanita*, 54(4), 316-323. https://doi.org/10.4415/ANN_18_04_08

- Albassam, A., Alshammari, S., Ouda, G., Koshy, S., & Awad, A. (2018). Knowledge, perceptions and confidence of physicians and pharmacists towards pharmacogenetics practice in Kuwait. *PLOS ONE*, 13(9), e0203033. <https://doi.org/10.1371/journal.pone.0203033>
- Atutornu, J., & Hayre, C. M. (2020). A Survey Exploring Personalised Medicine amongst Radiography Academics within the United Kingdom. *Journal of Medical Imaging and Radiation Sciences*, 51(3), 443–450. <https://doi.org/10.1016/j.jmir.2020.05.013>
- Girardi Lavín, G., Hoehn, M., Amar, M., Vásquez, D., & Walker, J. (2022). Chile tiene Futuro desde sus Territorios. Ediciones Biblioteca del Congreso Nacional de Chile.
- Hoxhaj, I., Beccia, F., Morsella, A., Cadeddu, C., Ricciardi, W., & Boccia, S. (2023). A survey of experts on personalized medicine landscape in European Union and China. *BMC Health Services Research*, 23, 517. <https://doi.org/10.1186/s12913-023-09471-y>
- Kim, W.-Y., Kim, H.-S., Oh, M., & Shin, J.-G. (2020). Survey of physicians' views on the clinical implementation of pharmacogenomics-based personalized therapy. *Translational and Clinical Pharmacology*, 28(1), 34–42. <https://doi.org/10.12793/tcp.2020.28.e6>
- Miller, F. A., Hayeems, R. Z., Bytautas, J. P., Bedard, P. L., Ernst, S., Hirte, H., Hotte, S., Oza, A., Razak, A., Welch, S., Winquist, E., Dancey, J., & Siu, L. L. (2014). Testing personalized medicine: Patient and physician expectations of next-generation genomic sequencing in late-stage cancer care. *European Journal of Human Genetics*, 22(3), 391–395. <https://doi.org/10.1038/ejhg.2013.158>
- Najafzadeh, M., Davis, J. C., Joshi, P., & Marra, C. (2013). Barriers for integrating personalized medicine into clinical practice: A qualitative analysis. *American Journal of Medical Genetics Part A*, 161(4), 758–763. <https://doi.org/10.1002/ajmg.a.35811>
- National Human Genome Research Institute. (2023a). *Precision Medicine*. Genome.gov. <https://www.genome.gov/genetics-glossary/Precision-Medicine>
- National Human Genome Research Institute. (2023b). *Genómica*. Genome.gov. <https://www.genome.gov/es/genetics-glossary/Genomica>
- OECD Chile: A healthier tomorrow. Paris: OECD, (2019). Available from: <https://www.oecd.org/health/health-systems/OECD-Reviews-of-Public-Health-Chile-Assessment-and-recommendations>

- Stallings, S. C., Richmond, J., Canedo, J. R., Beard, K., Bonnet, K., Schlundt, D. G., Wilkins, C. H., & Aldrich, M. C. (2023). Assessing patient-level knowledge of precision medicine in a community health center setting. *Journal of Community Genetics*, 14(2), 197–210. <https://doi.org/10.1007/s12687-023-00632-4>
- Stefanicka-Wojtas, D., & Kurpas, D. (2023). Personalised Medicine—Implementation to the Healthcare System in Europe (Focus Group Discussions). *Journal of Personalized Medicine*, 13(3), 380. <https://doi.org/10.3390/jpm13030380>
- The Economist Intelligence Unit. (n.d.). *Medicina personalizada en América Latina Universalizar la promesa de la innovación*. Retrieved June 15, 2023, from https://sofagem.org/sofagem_control/files/fck/file/SPA%20EIU%20Personalised%20medicine%20AL%20report%20RGB%20Full.pdf
- Weldon, C. B., Trosman, J. R., Gradishar, W. J., Benson, A. B., & Schink, J. C. (2012). Barriers to the Use of Personalized Medicine in Breast Cancer. *Journal of Oncology Practice*, 8(4), e24–e31. <https://doi.org/10.1200/JOP.2011.000448>