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Letter

BRAF-testing medical education needs in Latin America

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While the specter of cancer looms large globally, Latin America and the Caribbean are experiencing an escalation, with colorectal cancer (CRC) and malignant melanoma (MM) representing particularly pressing concerns. The rise in CRC, which ranks among the top five cancers in nearly 80% of the countries in this region, is emblematic of the economic development and westernization occurring in Latin America and the Caribbean.[1] V-Raf murine sarcoma viral oncogene homolog B (*BRAF*), a gene associated with various cancers, plays a significant role in both CRC and MM. Approximately 10% of metastatic CRCs have a *BRAF* mutation, which is strongly associated with a poor prognosis.[2] Additionally, approximately one in two advanced MMs, particularly those that are inoperable or have metastasized, exhibit *BRAF* gene mutations.[3]

CRC is expected to account for 2.2 million new cases and 1.1 million deaths globally by 2030.[4] Within the Latin American and Caribbean region, CRC is especially prevalent in Trinidad and Tobago, Uruguay, Barbados, and Argentina. The sharpest increase in CRC mortality trends has been observed in Brazil, Chile, and Mexico.[5] Lifestyle-related factors, including diet, a lack of physical activity, and obesity contribute, although the high incidence and mortality rates of CRC can also be attributed to inadequate screening programs, delayed diagnosis, and suboptimal treatment. These shortcomings are, in turn, reflective of the inadequate organization of healthcare systems and prevailing social, cultural, and economic inequalities.[6]

MM is characterized by high mortality rates worldwide, further underscoring the importance of early detection. When diagnosed early, MM has a five-year survival rate of 95%, which drastically decreases to 5% in metastatic cases.[7] In just 4 years, Colombia has recorded a significant surge in MM cases, from four cases per 100,000 individuals to six.[8] Latin American countries have a distinct distribution of MM histopathological subtypes, with acral lentiginous melanoma being the most prevalent.[9] Identifying the risk factors for MM is vital, especially given the lack of clarity regarding possible associations such as trauma.[10,11]

In the region, CRC and MM collectively accounted for 4924 and 63,798 deaths, respectively, translating into 134,433 and 1,497,360 disability-adjusted life years (DALYs). Brazil, Argentina, Mexico, and Colombia have been the most affected.[12]

Recent advancements in targeted therapies have emphasized the critical role of *BRAF* mutations in CRC and MM and have steered personalized treatment strategies. *BRAF* mutations have progressed from being simple prognostic biomarkers to actionable genetic alterations that are central to treatment decisions.[2,3] Despite its significance, however, there is a striking lack of studies examining the understanding and knowledge of healthcare professionals in Latin America and the Caribbean regarding *BRAF* mutations and the importance of *BRAF* testing. Furthermore, there is no comprehensive registry of standard *BRAF*-testing practices in the region's healthcare facilities.

This article aims to illuminate the current landscape of *BRAF* tumors in Latin America by investigating the need for educational interventions among physicians involved in the prevention, diagnosis, and treatment of this type of cancer.

We conducted online surveys and qualitative interviews with physicians in South America, with a special focus on Argentina, Brazil, Colombia, Mexico, and Paraguay, including the following specialists:

- Dermatologists
- General Surgeons
- Oncologists

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- Colorectal Surgeons
- Oncological Surgeons
- Gastroenterologists
- Internal Medicine Physicians

The online survey was open to responses from June 15, 2022 to November 29, 2022, allowing participants to provide their input over a span of several months. Snowball sampling was used to reach physicians.[13] The sampling strategy used in this study initially involved identifying and recruiting a small number of physicians from the target specialties and countries. The initial participants were asked to refer or recommend other eligible physicians they knew who could participate in the study. This process continued iteratively, with each new participant referring additional participants, forming a "snowball" effect. Snowball sampling is a common approach used when accessing hard-to-reach populations, such as healthcare professionals,[14] to expand the sample size through referrals and personal networks.

A questionnaire was designed to assess the educational needs of physicians regarding *BRAF*. After focus meetings with specialists from the six areas listed in item 2.1 (*BRAF* Workgroup), 10 sub-areas of medical knowledge about *BRAF* were identified that could be applied in the medical practice of all these specialties. A series of statements were created to assess physicians' self-knowledge [Supplementary Table 1]. These statements were evaluated by physicians using a 5-point Likert scale (ranging from 1 = strongly disagree to 5 = strongly agree).

The statistical program STATA 16.0 was used for the statistical analysis. After collecting the survey responses, we reviewed the data for duplicate entries or repeated submissions from the same participant, using emails as unique identifiers. We then performed a descriptive analysis of the sample. Means and standard deviations were calculated for continuous variables (i.e., age and Likert scale score), and counts and proportions were calculated for categorical variables (i.e., type of medical specialty and gender). Student's *t*-tests were used to compare mean self-awareness scores by country of origin (Brazil *vs.* Others). Subsequently, we performed analyses with the Student's *t*-test to compare the scores within and between medical specialties using the whole sample. For this, we created dummy variables for each medical specialty. Unfortunately, the low number of oncology surgeons and coloproctologists did not allow this type of analysis for these specialties.

Supplementary Table 2 shows the characteristics of our sample, divided into two groups: Brazil and Others. We found no differences between the two groups in terms of the age and gender of the participating physicians. The average age of the entire sample was 37.3 years, and most physicians were female (62.2%). However, in terms of medical specialties, there were significant differences between the two groups. The Brazilian subgroup included more colorectal surgeons, gastroenterologists, general practitioners, and oncologists. In the subgroup from the other Latin American countries, there were more dermatologists, general surgeons, and oncologists. In the overall sample, dermatologists were the most prevalent specialists (34.9%), followed by general surgeons (19.8%). Coloproctology and oncological surgery had the lowest representation, accounting for only 1.7% and 3.5% of the physicians, respectively.

The 10-item scale showed excellent internal consistency (alpha = 0.98). Figure 1 shows the average self-reported knowledge scores for *BRAF* tumors across different medical specialties in the whole sample. Oncologists achieved significantly higher scores than all the other specialists in all domains, with the lowest scores observed in the "Urgency" domain. Apart from the oncologists, dermatologists scored significantly higher than the other specialists in all domains, albeit with relatively lower scores in the "Test Interpretation" and "Treatment Prescription" domains. Gastroenterologists scored significantly lower than their peers in all domains, particularly in the "Pathophysiology" and "Need to Order a Test" domains. General surgeons obtained significantly lower scores than their peers in most knowledge domains, with the lowest scores in the "Test Interpretation", "Diagnosis", and "Prognosis" domains. Interestingly, there were no differences in the "Need to Order a Test", "Type of Patient", and "Urgency" domains. Internal medicine physicians scored significantly lower than their peers in all domains, with the lowest scores in the "Type of Treatment" and "Need to Order a Test" domains.

The significantly higher knowledge scores among oncologists compared to the other specialists in all domains may initially seem

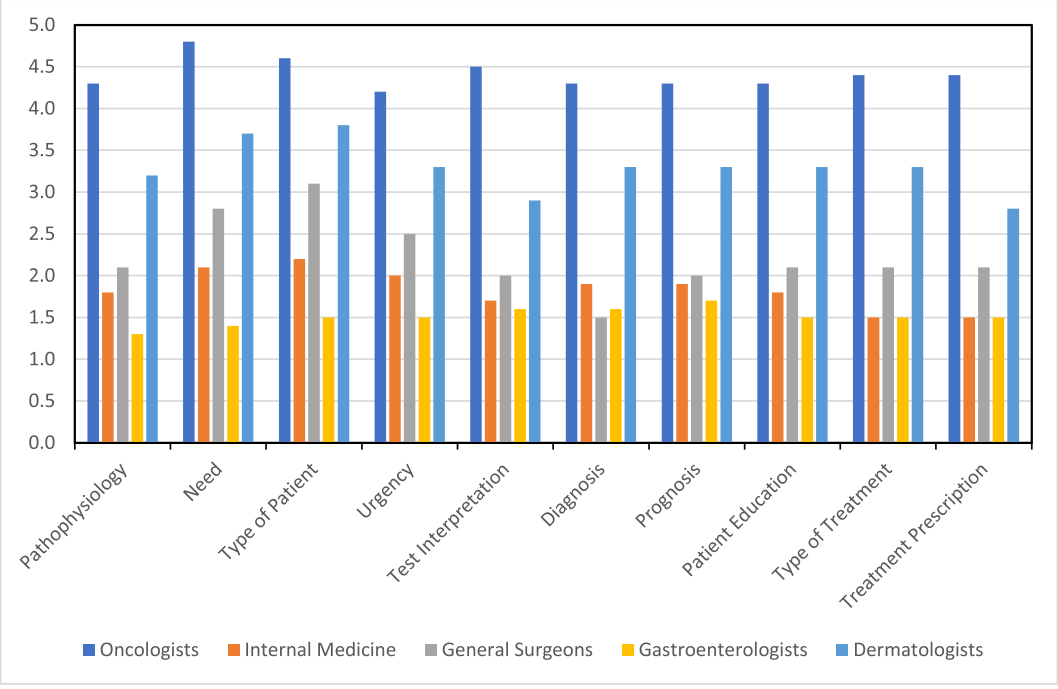

Figure 1. Self-reported knowledge on V-Raf Murine Sarcoma Viral Oncogene Homolog B-tumors (*BRAF*-tumors) among different medical specialties, Latin America, 2022.

encouraging. It is generally expected that oncologists, who specialize in the treatment of cancer, will have a greater knowledge of specific cancer types and mutations, including *BRAF* mutations, than physicians who do not specialize in oncology. However, it is important to critically evaluate the practical implications of these findings. High knowledge does not guarantee effective clinical decision-making or improved patient outcomes. This study's reliance on self-reported knowledge introduces the potential for bias and overestimation. Objective assessments of knowledge and evaluations of its impact on clinical practice and patient outcomes are crucial to ascertain whether the higher knowledge scores among oncologists translate into better care.

The significantly higher scores by dermatologists than all the other specialists apart from oncologists in most knowledge domains were an expected finding given their specialization in skin disorders and cancers, including melanoma. Dermatologists may have a greater knowledge of *BRAF*-mutated cancers, specifically melanoma, given this specialization. *BRAF* V600 mutations are found in approximately 50% of melanomas, making molecular testing for *BRAF* mutations important for determining treatment plans. However, the focus of this study on *BRAF*-mutated cancers raises questions about the depth and breadth of dermatologists' knowledge beyond their core area of expertise. Are dermatologists adequately informed about the implications of *BRAF* mutations in other types of cancer? Limited knowledge outside their specialty may hinder their ability to provide comprehensive care and collaborate effectively with other specialists. This calls for a critical evaluation of interdisciplinary communication and the need for comprehensive training programs that address the broader landscape of *BRAF*-mutated cancers.

The lower knowledge scores among gastroenterologists and general surgeons in various domains related to *BRAF*-mutated cancers are concerning. The level of knowledge regarding *BRAF*-mutated CRCs may vary among gastroenterologists because cancer is not their primary area of expertise. Although they are likely to have some knowledge of the significance of *BRAF* mutations in CRC, they may not have the same level of in-depth knowledge as oncologists and other specialists who focus specifically on cancer diagnosis and treatment. Nevertheless, gastroenterologists play a vital role in CRC screening, diagnosis, and management, including the identification of *BRAF* mutations. The lower knowledge scores in this study suggest an inadequate understanding of the significance of *BRAF* mutations in CRC. This raises concerns about the accuracy of diagnoses, treatment decisions, and patient outcomes. It is imperative that these knowledge gaps be addressed through targeted educational interventions and quality improvement initiatives to ensure that gastroenterologists are equipped with the necessary knowledge to provide optimal care to patients with *BRAF*-mutated CRC.

Similarly, the lower knowledge scores among general surgeons, particularly in areas such as "Test Interpretation", "Diagnosis", and "Prognosis", highlight potential deficiencies in the management of *BRAF*-mutated rectal cancer. As rectal cancer often falls within the purview of general surgeons, their limited understanding of the latest developments, treatment options, and prognostic implications related to *BRAF* mutations raises significant concerns. Inadequate knowledge may lead to suboptimal treatment decisions, compromised patient outcomes, and missed opportunities for personalized care. Efforts should be directed toward targeted education programs and ongoing professional development to address these knowledge gaps among general surgeons.

A recent review by experts has identified several barriers impeding the development of early *BRAF* testing in Latin America, thereby endangering the potential for personalized therapies and care. Measures proposed to overcome these barriers include improving knowledge, treatment options, equitable distribution, timely results, and local data on *BRAF* mutations. Our study contributes specific data on the varying levels of knowledge among different medical specialties in Latin America, which could be advantageous for developing educational programs focused on *BRAF*-type tumors for physicians in the region.

Although this study provides valuable insights into self-reported knowledge levels, it is crucial to recognize the limitations associated with self-reporting. Self-assessment of knowledge may not always align with actual clinical practice or decision-making abilities. The focus of this study on self-reported knowledge alone limits the ability to draw firm conclusions about the quality of patient care provided by different specialties. Further research is needed to evaluate the correlation between knowledge levels, clinical performance, and patient outcomes to gain a more comprehensive understanding of the impact of knowledge on patient care.

This is a rare study that assessed self-reported medical knowledge among different specialties involved in *BRAF* cancer care in Latin America. Oncologists scored significantly higher in all domains, followed by dermatologists, who scored significantly higher than all the other specialists in all domains except for "Test Interpretation" and "Treatment Prescription." Gastroenterologists scored significantly lower than their peers in all domains, with the lowest scores for the "Pathophysiology" and "Need to Order a Test" domains. General surgeons scored significantly lower than their peers in most knowledge domains, with the lowest scores for "Test Interpretation", "Diagnosis", and "Prognosis".

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Authors contribution

Conceptualization: João Mauricio Castaldelli-Maia (JMCM); Methodology: JMCM; Formal analysis: JMCM; Investigation: JMCM, Gislaine Koch Gimenes (GKG), Giuliana Perrotte (GP), Stefani Gonzalez (SG), Ainur Okassova (AO), Karina Malvido (KM), Julio Torales (JT); Data Curation: JMCM; Writing - Original Draft: JMCM, JT; Writing - Review & Editing: JMCM, GKG, GP, SG, AO, KM, JT; Supervision: JMCM, JT; Funding acquisition: JMC.

Ethics statement

The School of Medical Sciences of National University of Asuncion waived the requirement for ethical approval and informed consent of this study. The study was conducted as a test within normal educational requirements and was intended solely for educational improvement purposes. This study was regarded as research that did not require an ethics review, as we conducted testing within normal educational requirements for education improvement purposes.[15]

Data availability statement

All the data collected for this study have been presented in the manuscript. However, owing to confidentiality concerns, individual-level data cannot be shared with other investigators.

Conflict of interest

Pfizer had no role in the study design, collection, analysis, or interpretation of the data, the writing of the manuscript, or the decision to submit the paper for publication.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cpt.2023.07.002.

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