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Methodology for Mapping Personality Traits in Radiopharmaceutical Production at IPEN Based on the Big Five Model

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1. Introduction

Over the past decades, the contribution of teams and their leaders to organizational performance has assumed an increasingly relevant role across different productive sectors [1,2]. In this context, behavioral competencies have come to be considered strategic elements for professional performance, especially in environments characterized by high technical, operational, and safety complexity.

Despite their relevance, behavioral aspects represent a significant challenge for people management, since they involve subjective, intangible, and difficult-to-measure characteristics. In this scenario, Human Resources professionals play a fundamental role in supporting processes such as recruitment, assessment, development, and talent retention. To achieve this, psychometric instruments are increasingly used to measure, classify, and interpret behavioral tendencies in a more objective manner.

Among the main models used to assess human personality, the Five Factor Model (FFM), also known as the Big Five model, stands out due to its scientific robustness, psychometric validation, and predictive validity in studies related to human behavior and work performance [3,4]. The model organizes personality into five major dimensions: Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Emotional Stability (or Neuroticism in some approaches).

The use of Big Five-based instruments has expanded in organizational research due to their applicability to occupational performance, leadership, teamwork, human factors and safety behaviour. However, evidence regarding their application in safety-critical nuclear environments remains limited, supporting the need for methodological studies in this field.

In this context, the production of radiopharmaceuticals at the Nuclear and Energy Research Institute (IPEN) is particularly relevant, as the institution is responsible for a significant portion of the national supply of these strategic inputs for nuclear medicine. Radiopharmaceuticals are widely used in diagnostic and therapeutic procedures, including Positron Emission Tomography (PET), scintigraphy, and targeted treatments for specific diseases, including several types of cancer.

The increasing national demand for radiopharmaceuticals imposes challenges related not only to production infrastructure, but also to the training, management, and retention of qualified professionals capable of operating in environments that require high levels of technical,

operational, and regulatory rigor. Therefore, understanding the predominant behavioral characteristics among professionals involved in the production and handling of radiopharmaceuticals may contribute to the development of more effective people management strategies within this sector. Human factors and safety culture have been recognized as key elements for operational reliability in high-risk industries such as aviation, healthcare, and nuclear technology [5–7].

The present paper describes the methodology that will be used to investigate the personality profile of professionals involved in the radiopharmaceutical production process at the Nuclear and Energy Research Institute, through the application of the Brazilian Big Five psychometric instrument, based on the Five Factor Model (FFM) [8].

2. Methodology

The methodology for the present study will adopt a quantitative, exploratory, and comparative design and will be conducted at the Nuclear and Energy Research Institute (IPEN), involving professionals working in radiopharmaceutical production. The future study aims to characterize personality profiles within this occupational context and investigate possible associations between personality traits and objective organizational indicators related to professional performance and safety behavior, evaluating the potential contribution of psychometric assessment to strategic people management in highly regulated environments.

The selection of the radiopharmaceutical sector is justified by the increasing relevance of these substances in nuclear medicine, particularly in diagnostic and therapeutic applications related to the treatment of cancer and cardiovascular diseases. Furthermore, previous studies have demonstrated projected growth in national demand for radiopharmaceuticals such as ^{99}mTc and ^{18}F-FDG, indicating the need to expand production capacity and strengthen people management practices within the sector [9, 10].

To assess personality traits, the Brazilian Big Five psychometric instrument will be used. The instrument is grounded in the Five-Factor Model (FFM), one of the most widely accepted frameworks for personality assessment, and has been adapted for application in organizational contexts. The choice of this model is supported by extensive evidence demonstrating the relationship between personality traits and work-related outcomes, including job performance, leadership effectiveness, teamwork, and occupational adjustment [11,12].

The questionnaire will be administered online and consists of 120 items rated on a five-point Likert scale. Results are presented using percentile scales covering the five major personality factors and their respective subtraits, enabling quantitative comparative analyses between individuals and occupational groups.

The instrument underwent psychometric validation using a sample of more than 15,000 Brazilian respondents and provides percentile scores for comparison across occupational groups.

The model adopted in this study considers the five major personality factors widely recognized in the scientific literature: Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Emotional Stability.

The planned statistical analyses will be conducted in three complementary stages. First, descriptive and comparative analyses will characterize personality profiles across occupational roles, technical functions, operational areas, and leadership levels within radiopharmaceutical production. Personality profiles will also be compared with those of professionals occupying equivalent occupational roles in other sectors to investigate whether this occupational context presents distinctive behavioral characteristics. Second, predictive analyses will examine possible associations between personality traits and organizational outcomes. Depending on the nature of the dependent variable, generalized regression models appropriate to the measurement level of each outcome variable will be employed, including binary logistic regression for dichotomous outcomes.

Planned analyses will investigate possible associations between personality traits and membership in the radiopharmaceutical workforce, leadership positions, and validated organizational indicators related to

professional performance and safety behavior, such as compliance with operational and radiation protection procedures, participation in safety training, safety compliance, correct use of personal protective equipment, reporting of near-miss events, and other institutional indicators, when available.

These indicators were selected because they represent observable and objective dimensions of safety behavior, human reliability, and safe operational performance in highly regulated environments.

For the purposes of this study, professional performance will be operationalized through validated organizational indicators and occupational outcomes rather than occupational position alone.

Relevant demographic and occupational variables will be considered as covariates whenever appropriate. Effect sizes, odds ratios, 95% confidence intervals, and model goodness-of-fit statistics will be reported according to the statistical model employed. Sample size adequacy and statistical power will be evaluated after data collection.

The expected findings will be discussed in light of the literature on personality, occupational performance, human factors, safety behavior, human reliability, safety culture, and high-reliability organizations.

3. Expected Results and Discussion

The present study aims to identify predominant behavioral patterns among professionals involved in the production and handling of radiopharmaceuticals, considering the technical, operational, and safety-related specificities inherent to this occupational context. This paper presents the research design of an ongoing study to verify whether possible statistically significant differences differences exist between the personality traits of these professionals and those observed in distinct occupational groups, as well as to analyze possible variations across leadership levels and professional functions within the sector.

The expected findings may support future discussions on people management in highly regulated environments, particularly regarding professional development, training, workforce planning, and organizational learning. Any potential application as support to recruitment or personnel allocation should depend on future evidence of criterion validity, fairness assessment, ethical safeguards, and appropriate professional interpretation.

Furthermore, the study may provide support for future investigations involving professionals working in radiopharmacy clinics and nuclear medicine services, including physicians, biomedical scientists, nurses, and technologists, thereby expanding the understanding of human factors and predominant behavioral characteristics across different segments of nuclear medicine.

4. Conclusions

The increasing complexity of productive environments and the growing national demand for radiopharmaceuticals reinforce the need for more structured, evidence-based people management strategies aimed at supporting human reliability. In this context, the application of psychometric instruments grounded in the Big Five model may provide a valuable methodological approach for expanding the understanding of human factors involved in radiopharmaceutical production.

The present study is expected to contribute to the investigation of the personality profiles of professionals working in this sector at IPEN, aiming to identify personality profiles associated with the technical, operational, and safety-related demands characteristic of radiopharmaceutical production. The expected findings may contribute to the improvement of strategic people management practices, supporting processes such as talent management, retention, and professional development.

As an ongoing study, this research is expected to provide relevant insights for discussions on operational safety, organizational performance, and human factors in high-reliability environments. By investigating the personality profiles of professionals involved in radiopharmaceutical production, the study may support future discussions regarding people management models more closely aligned with the demands of the nuclear and radiopharmaceutical sectors.

Finally, the study is expected to provide a methodological foundation for future investigations involving professionals in nuclear medicine and other high-reliability sectors. Future empirical studies may investigate possible associations between personality traits and validated organizational indicators

related to occupational performance, human factors, human reliability, and safety behavior, allowing comparisons with other safety-critical industries.

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