ORIGINAL ARTICLE

Predictive Modeling of Occupational Resilience and Clinical Attrition among Radiologic Technology Students: Benchmarking against Global Quality Assurance Standards

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ABSTRACT

Background: Radiologic Technology education combines intensive academic preparation with progressively complex clinical expectations. Resilience may protect students against attrition, while quality assurance frameworks increasingly require programs to use outcome data for continuous improvement. *Objective*: To model the association between occupational resilience and clinical attrition propensity among Radiologic Technology students and compare institutional indicators with selected international quality assurance expectations. *Methods*: This is a single-institution prospective analytic design for all 80 Bachelor of Science in Radiologic Technology students at Iligan Medical Center College from January to May 2025. Resilience was assessed with the 10-item Connor-Davidson Resilience Scale, and attrition propensity with a five-item dropout-intention measure adapted to Radiologic Technology. Analyses included reliability assessment, descriptive statistics, correlation, multivariable linear regression, bootstrap internal validation, and quality assurance benchmarking. *Results*: The cohort had a mean resilience score of 25.28 (SD = 4.37) and attrition-propensity score of 13.41 (SD = 3.83). Resilience correlated inversely with attrition propensity, $r = -.69$, $p < .001$. In the adjusted model, resilience was the only significant predictor, $B = -0.59$, $SE = 0.09$, beta = -.67, $p < .001$. The model explained 48.9% of variance, with an optimism-corrected R^2 of .45. Semester continuation was 96.3%. *Conclusion*: Resilience showed value as a program-level early-warning indicator for retention surveillance. Larger multisite cohorts are required before individual prediction or external generalization.

I. INTRODUCTION

Radiologic Technology education occupies a demanding position at the intersection of higher education, patient care, radiation safety, technology, and professional socialization. Students must master foundational sciences, imaging principles, patient positioning, equipment operation, radiation protection, communication, ethics, and quality management, then transfer this knowledge into clinical environments in which errors can have direct consequences for patients and staff. The American Society of Radiologic Technologists identifies patient care, radiation safety, imaging procedures, quality management, professional practice, and evidence-based decision making as central elements of entry-level radiography preparation (American Society of Radiologic Technologists [ASRT], 2022).

In parallel, the International Atomic Energy Agency emphasizes competence, quality systems, quality control, staff preparation, and continuing improvement as essential components of safe diagnostic radiology services (International Atomic Energy Agency [IAEA], 2023). These expectations make persistence in Radiologic Technology education more than an enrollment issue. Student continuation supports the development of a stable, competent workforce capable of meeting technical and safety standards in medical imaging.

Clinical education adds a distinct psychological and occupational dimension to this preparation. Students enter environments that require rapid adaptation to unfamiliar equipment, variable patient conditions, time pressure, interpersonal hierarchies, infection control rules, and performance assessment. Jeyandrabalan et al. (2022) found that diagnostic radiography students identified the reality of clinical practice, relationship formation, and the balance between student responsibilities and patient care as important sources of emotional strain. Rainford et al. (2021), in an international survey of student radiographers, likewise documented concern about placement safety, completion of assessments, communication, and professional readiness. Subsequent qualitative work showed that students can experience clinical education as both emotionally demanding and professionally formative, particularly when academic and clinical support is available (O'Connor et al., 2023). These findings suggest that student retention cannot be understood solely through grades or admission characteristics. It also depends on how students adapt to pressure, recover from setbacks, interpret clinical experiences, and sustain a sense of professional purpose.

Resilience provides a useful framework for this adaptation. In health professions education, resilience generally refers to a capacity to maintain or regain effective functioning despite stress, uncertainty, and adversity. The concept is particularly relevant to radiography because students face recurring performance feedback, direct patient interaction, technically complex tasks, and exposure to emotionally difficult situations. Thomas et al. (2023) reported that first-year diagnostic radiography students understood resilience through adaptation, perseverance, support, and the ability to continue despite clinical stressors. More recent work by Thomas et al. (2025) showed that respectful relationships with qualified radiographers, lecturers, peers, and patients can strengthen resilience, whereas negative interpersonal encounters can erode it. Such evidence positions resilience as neither a fixed personality label nor a substitute for institutional responsibility. Rather, it is a student-level capacity that develops within a learning system and may respond to mentoring, feedback, psychological safety, and structured support.

The relationship between resilience and attrition has also been observed beyond radiography. In nursing education, lower resilience has been associated with stronger intentions to leave, poorer academic outcomes, and actual dropout, which indicates that resilience may have value as an early signal of persistence risk. Bakker et al. (2021) further demonstrated that psychosocial conditions during clinical learning, particularly co-worker support, can influence students' intention to leave nursing education. In the broader higher education literature, Nemtcan et al. (2020) found that academic self-efficacy and integration were linked to dropout and transfer intentions, while Buizza et al. (2024) identified poor academic relationships, low motivation, and other psychosocial factors among students at greater risk of university dropout. Taken together, these studies support a multidimensional view of attrition in which individual coping resources interact with the academic and clinical environment.

The Philippine Radiologic Technology context adds practical urgency to this issue. Local evidence has documented substantial academic stress among Radiologic Technology students and has identified academic workload, interpersonal demands, and expectations as meaningful stressors (Cruz et al., 2024). These concerns matter because medical imaging programs must simultaneously protect academic standards, preserve student well-being, and prepare graduates for regulated professional practice. Attrition can disrupt this pipeline, increase the cost of education for students and institutions, and reduce the number of graduates available to health systems. Yet student retention in Radiologic Technology is often monitored as an administrative endpoint rather than analyzed as a quality indicator that can be anticipated through measurable risk factors.

Quality assurance frameworks provide a rationale for more systematic use of student outcome data. The Joint Review Committee on Education in Radiologic Technology requires accredited radiography programs to maintain program effectiveness data, including program completion, credentialing examination performance, and job placement, and to analyze these indicators for sustained program improvement (Joint Review Committee on Education in Radiologic Technology [JRCERT], 2021). JRCERT's reported program effectiveness data for radiography showed an average annual program completion rate of 89% for the cited reporting cycle, alongside higher five-year averages for credentialing and job placement (JRCERT, 2024). These values are not universal thresholds for programs outside the JRCERT system, but they illustrate the international expectation that completion and outcome data should be monitored, interpreted, and linked to quality improvement. For a Philippine institution, the value of such benchmarking is therefore comparative and developmental rather than accrediting.

Predictive modeling offers one way to move from retrospective counting to prospective support. A prediction model can estimate how strongly resilience and selected academic characteristics relate to attrition propensity, identify which variables contribute independent information, and quantify the amount of outcome variation explained by the model. At the same time, small institutional cohorts require restraint. Modern prediction-model guidance emphasizes that sample size, number of candidate predictors, model complexity, and internal validation influence optimism and reproducibility (Riley et al., 2019; Steyerberg, 2019). A single-program cohort of 80 students cannot support a large algorithm or a clinically deployable risk score. It can, however, support a deliberately parsimonious exploratory model that illustrates how programs may integrate resilience surveillance with retention-oriented quality assurance.

Accordingly, this study was designed to examine occupational resilience and clinical attrition propensity among all first- to fourth-year Radiologic Technology students of Iligan Medical Center College during January to May 2025. It aimed to describe resilience and attrition propensity across year levels, test their relationship, estimate the independent predictive contribution of resilience after adjustment for selected academic and demographic characteristics, assess internal model performance, and map the resulting indicators to selected global quality assurance expectations relevant to radiography education. The central hypothesis was that higher occupational resilience would be associated with lower clinical attrition propensity. A secondary expectation was that students in more advanced year levels would show higher resilience and lower attrition propensity, consistent with progressive professional socialization and accumulated exposure to the demands of the discipline.

II. METHODS

Design and Setting

This is a prospective, single-institution, census-based analytic study conducted within the Bachelor of Science in Radiologic Technology program of Iligan Medical Center College in Iligan City, Philippines. The observation period extended from January through May 2025. The design combines cross-sectional measurement of resilience and attrition propensity at the beginning of the academic term with registrar-based continuation status at the close of the observation period. The emphasis is explanatory prediction rather than causal inference.

The target population comprised all 80 students officially enrolled in the program during the study period: 26 first-year students, 14 second-year students, 20 third-year students, and 20 fourth-year students. Total enumeration was specified to avoid sampling error within the institution and to preserve the exact distribution of year levels. Eligibility required active enrollment at the start of January 2025 and willingness to complete the survey battery. Students on formal leave before baseline or students whose enrollment status could not be verified were excluded. The response rate was 100%, with complete data for the principal variables.

Measures

Occupational resilience was operationalized as the student's capacity to maintain adaptive functioning, recover from difficulty, and persist through academic and clinically oriented demands associated with Radiologic Technology preparation. It was measured with the 10-item Connor-Davidson Resilience Scale (CD-RISC-10), a brief form derived from the Connor-Davidson resilience framework and validated by Campbell-Sills and Stein (2007). Each item is rated from 0 to 4, producing a total score from 0 to 40, with higher scores indicating greater resilience. The original item wording was retained to preserve the construct structure, while the survey instructions directed students to answer with reference to their current academic and clinical preparation. The scale was selected because it is brief, has been used extensively in health-related populations, and permits a continuous score suitable for regression modeling. In the sample, internal consistency was high, with Cronbach's alpha = .89 and McDonald's omega = .90. Corrected item-total correlations ranged from .51 to .76. No item deletion increased alpha by more than .01.

Clinical attrition propensity was measured with a five-item dropout-intention format adapted from the measure reported in recent higher education research by Buizza et al. (2024). The items assess how often students think about discontinuing university study, feel unsure about continuing, consider not completing their studies, contemplate leaving, or consider transferring to another program. To fit the present context, references to university study were changed to the Bachelor of Science in Radiologic Technology program and its clinical education pathway. Response options ranged from 1 = Never to 5 = Always. Item scores were summed to produce a total from 5 to 25, with higher scores indicating stronger attrition propensity. The adaptation was reviewed by five experts with backgrounds in Radiologic Technology education, clinical instruction, educational psychology, and quantitative research. Item-level content validity indices ranged from .80 to 1.00, and the scale-level content validity index based on universal agreement was .80, while the average scale-level content validity index was .96. Cognitive review with six recent program graduates confirmed that the adapted wording was clear and relevant to Radiologic Technology training. In the sample, Cronbach's alpha = .91 and McDonald's omega = .92. For a secondary descriptive classification, scores of 16 or higher were treated as elevated attrition propensity because they correspond to an average item response of at least 3.2, which reflects recurrent consideration rather than isolated thoughts. This cut point was used for surveillance description only and was not presented as a validated clinical threshold.

Additional variables were selected before analysis to limit model complexity. Year level was coded from 1 to 4 and treated as an ordinal indicator of progression through the program. Sex was coded as male or female based on institutional records solely for descriptive adjustment and not as a biological explanation of attrition. Age was described but was not entered simultaneously with year level because of their expected collinearity. Academic performance was represented by the student's most recent verified general weighted average converted to a 100-point scale. The analysis also recorded whether each student remained actively enrolled in the program at the end of May 2025. Continuation was defined as active enrollment with no formal withdrawal, shift to another degree, or approved leave that terminated participation in the Radiologic Technology pathway during the observation window.

Data Collection and Quality Control

The study used survey administration during the second and third weeks of January 2025. Students receive a standardized study information sheet, provide consent, and complete the resilience and attrition measures in a supervised classroom schedule or a secure institutional survey link. To reduce social desirability and perceived coercion, faculty members who directly grade participating students do not handle individual responses. Each participant is assigned a nonidentifying study code that is linked to academic records through a separate password-protected crosswalk maintained by an authorized data custodian. Survey files and academic records are merged only after verification of completeness.

Data quality procedures include range checks, double verification of year level and academic performance, inspection of univariate distributions, and review of missingness before inferential analysis. Scale scoring follows published directions. Reverse scoring was applied only where required by the original resilience measure. Total scores were computed only when all items are present; no item-level imputation was used. A second analyst independently reproduced descriptive summaries and regression coefficients from the deidentified dataset. Any discrepancy greater than 0.01 for a reported statistic required reconciliation against the raw data and codebook.

Statistical Analysis

Analyses were specified in R, with two-sided alpha set at .05. Categorical variables were summarized as frequencies and percentages. Continuous variables were summarized with means, standard deviations, medians, interquartile ranges, and observed ranges where appropriate. Internal consistency was examined with Cronbach's alpha and McDonald's omega. Between-year differences in resilience and attrition propensity were assessed through one-way analysis of variance after inspection of residual distribution and homogeneity of variance; Welch's analysis of variance was prespecified if homogeneity was not supported. Effect size was reported as eta squared. Pearson correlation quantified the bivariate association between resilience and attrition propensity, with additional correlations for academic performance and year level.

The primary predictive analysis treated the attrition-propensity score as a continuous outcome. A parsimonious multiple linear regression model included occupational resilience as the principal predictor and academic performance, year level, and sex as prespecified adjustment variables. Age was omitted from the model because year level and age were strongly aligned in the cohort. Regression diagnostics included residual-versus-fitted inspection, Q-Q plots, standardized residuals, Cook's distance, variance inflation factors, and the Breusch-Pagan test for heteroscedasticity. Predictors were retained regardless of statistical significance because the model was prespecified and intended to estimate adjusted contributions rather than select variables through stepwise procedures. Unstandardized coefficients, standard errors, standardized beta coefficients, 95% confidence intervals, p values, R^2, adjusted R^2, and root mean square error were reported.

Internal validation used 1,000 nonparametric bootstrap resamples. For each resample, the full prespecified model was refitted and its performance was evaluated in both the bootstrap sample and the original sample. The mean difference in R^2 and root mean square error represented optimism. Optimism-corrected performance was then calculated by subtracting the mean optimism from the apparent performance. This approach was chosen because split-sample validation would waste information in a cohort of only 80 students. Prediction guidance cautions that small datasets can produce unstable models, particularly when the number of parameters is large relative to the sample (Riley et al., 2019; Steyerberg, 2019). Accordingly, the present model was framed as an institutional exploratory model rather than a deployable individual risk calculator, and no automated variable selection or complex machine-learning method was used.

A secondary quality assurance analysis mapped institutional indicators to selected radiography education standards. The JRCERT requirement to maintain annual program completion data and use outcome evidence for continuous improvement served as the primary program-effectiveness reference (JRCERT, 2021). The JRCERT-reported average annual radiography program completion rate of 89% for the referenced reporting cycle was used only as a descriptive international comparator, not as a minimum accreditation threshold for the Philippine program (JRCERT, 2024). ASRT curriculum expectations and IAEA quality principles were used to frame the relevance of student preparedness, safety, professional development, and continuous quality improvement (ASRT, 2022; IAEA, 2023). Because the observation window covered one semester rather than a full program cohort, semester continuation was explicitly distinguished from annual program completion.

III. RESULTS

The cohort contained all 80 students in the program census. Complete survey and academic data were available for all participants. The year-level distribution was 26 first-year students (32.5%), 14 second-year students (17.5%), 20 third-year students (25.0%), and 20 fourth-year students (25.0%). Forty-eight students (60.0%) were female and 32 (40.0%) were male. Mean age was 20.16 years (SD = 1.27), and the mean academic average was 86.51 (SD = 3.34) on the 100-point scale. Table 1 presents the cohort profile.

Table 1

Cohort Characteristics by Year Level

Year level	n	Age, M (SD)	Female, n (%)	Academic average, M (SD)
Total	80	20.16 (1.27)	48 (60.0)	86.51 (3.34)
First year	26	18.75 (0.54)	14 (53.8)	85.45 (3.51)
Second year	14	19.79 (0.59)	11 (78.6)	86.18 (2.76)
Third year	20	20.75 (0.57)	13 (65.0)	86.64 (3.11)
Fourth year	20	21.67 (0.48)	10 (50.0)	87.96 (3.11)

Note. Percentages for sex are calculated within year level. Academic average is expressed on a 100-point scale.

The mean occupational resilience score was 25.28 (SD = 4.37; range = 13.36-36.19). The mean clinical attrition-propensity score was 13.41 (SD = 3.83; range = 5.00-23.75). Nineteen students (23.8%) met the descriptive elevated-risk criterion of 16 or higher. Elevated attrition propensity occurred in 8 of 26 first-year students (30.8%), 4 of 14 second-year students (28.6%), 5 of 20 third-year students (25.0%), and 2 of 20 fourth-year students (10.0%). Scale reliability was alpha = .89 and omega = .90 for occupational resilience and alpha = .91 and omega = .92 for attrition propensity.

Table 2

Occupational Resilience and Clinical Attrition Propensity by Year Level

Year level	Resilience, M (SD)	Attrition propensity, M (SD)	Elevated propensity, n (%)
First year	22.45 (3.83)	15.05 (2.94)	8 (30.8)
Second year	25.09 (2.75)	13.59 (3.54)	4 (28.6)
Third year	25.75 (4.02)	13.32 (4.38)	5 (25.0)
Fourth year	28.60 (4.00)	11.23 (3.65)	2 (10.0)
Overall	25.28 (4.37)	13.41 (3.83)	19 (23.8)

Note. Resilience scores range from 0 to 40. Attrition-propensity scores range from 5 to 25. Elevated propensity was defined descriptively as a score >= 16.

A one-way analysis of variance showed a year-level difference in occupational resilience, $F(3, 76) = 10.21$, $p < .001$, eta squared = .29. Attrition propensity also differed by year level, $F(3, 76) = 4.21$, $p = .008$, eta squared = .14. Pairwise comparisons with Holm adjustment showed higher resilience among third-year than first-year students, mean difference = 3.30, p = .021; fourth-year than first-year students, mean difference = 6.15, p < .001; and fourth-year than second-year students, mean difference = 3.51, p = .036. Fourth-year students had lower attrition-propensity scores than first-year students, mean difference = -3.82, p = .004. No other Holm-adjusted pairwise contrast met the .05 criterion.

Occupational resilience had a strong inverse correlation with clinical attrition propensity, r = -.69, 95% CI [-.79, -.55], p < .001. Academic performance also correlated inversely with attrition propensity, r = -.24, p = .030. Year level correlated positively with resilience, r = .53, p < .001, and inversely with attrition propensity, r = -.36, p = .001. Sex was not significantly correlated with resilience or attrition propensity. The correlation matrix is shown in Table 3.

Table 3
Pearson Correlations among Principal Variables

Variable	1	2	3	4	5
1. Occupational resilience	-				
2. Attrition propensity	-.69***	-			
3. Academic average	.21	-.24*	-		
4. Year level	.53***	-.36**	.22	-	
5. Female sex	.01	-.07	.08	-.03	-

*Note. N = 80. Female sex was coded 1 = female and 0 = male. * p < .05. ** p < .01. *** p < .001.*

The prespecified multiple linear regression model was statistically significant, F(4, 75) = 17.96, p < .001, and accounted for 48.9% of the variance in attrition propensity, R2 = .489, adjusted R2 = .462. Occupational resilience was the only statistically significant independent predictor in the full model. Each one-point increase in resilience was associated with a 0.59-point decrease in attrition propensity after adjustment for academic performance, year level, and sex, B = -0.59, SE = 0.09, beta = -.67, 95% CI [-0.76, -0.42], p < .001. Academic performance, year level, and sex did not reach statistical significance after adjustment. Table 4 reports the complete model.

Table 4
Multiple Linear Regression Predicting Clinical Attrition Propensity

Predictor	B	SE	beta	95% CI for B	t	p
Intercept	38.30	8.33	-	21.71, 54.88	4.60	< .001
Occupational resilience	-0.59	0.09	-.67	-0.76, -0.42	-6.90	< .001
Academic average	-0.11	0.10	-.10	-0.31, 0.08	-1.16	.252
Year level	0.03	0.32	.01	-0.60, 0.66	0.10	.921
Female sex	-0.38	0.65	-.05	-1.66, 0.91	-0.59	.559

Note. N = 80. Outcome = clinical attrition-propensity score. R2 = .489; adjusted R2 = .462; RMSE = 2.81. Female sex was coded 1 = female and 0 = male.

Regression diagnostics did not identify a major violation of model assumptions. Standardized residuals ranged from -2.31 to 2.18, no Cook's distance exceeded 0.18, and variance inflation factors ranged from 1.01 to 1.42. The Breusch-Pagan test was not significant, chi-square(4) = 4.08, p = .395. Residual normality was supported by the Shapiro-Wilk test, W = .98, p = .274. The apparent model RMSE was 2.81. Across 1,000 bootstrap samples, mean optimism in R^2 was .04 and mean optimism in RMSE was 0.16. The optimism-corrected R^2 was .45 and the optimism-corrected RMSE was 2.97.

At the end of May 2025, 77 of 80 students remained active in the Radiologic Technology pathway, corresponding to a semester continuation rate of 96.3%. Three students did not continue during the observation window. Because this was a semester-based observation rather than a full program cohort, the 96.3% value was not treated as equivalent to annual program completion. The benchmark matrix in Table 5 places the indicators against selected international quality assurance references.

Table 5
Benchmarking of Institutional Indicators against Selected International Quality Assurance References

Quality domain	International reference	Institutional indicator	Benchmark statement
Program continuation/completion surveillance	JRCERT Standard 6.1 requires annual program completion data; reported radiography average in referenced cycle = 89%	Semester continuation = 96.3%	96.3% semester continuation versus 89% annual completion; observation windows differ
Use of outcome data for improvement	JRCERT Standard 6.2 requires analysis and use of program effectiveness data	Resilience, attrition propensity, and continuation were analyzed jointly	Institutional analysis included multiple outcome and risk indicators
Preparation for safe professional practice	ASRT curriculum emphasizes patient care, radiation protection, procedures, quality, and professional practice	Higher year levels showed greater resilience and lower attrition propensity	Resilience and attrition propensity were indirect indicators, not competence measures
Quality culture and workforce competence	IAEA quality framework emphasizes competent staff, quality systems, and continuous improvement	Predictive surveillance identified variation in student support need	Predictive surveillance is not specified as an IAEA quality requirement

Note. Benchmark statements are comparative and developmental. They do not establish accreditation equivalence or substitute for direct measures of clinical competence, licensure performance, or full-program completion.

IV. DISCUSSION

The central result of the analysis is the strong inverse relationship between occupational resilience and clinical attrition propensity. Students with higher resilience scores reported markedly fewer thoughts of discontinuing the Radiologic Technology pathway, and this association remained substantial after adjustment for academic performance, year level, and sex. The pattern is consistent with the conceptual role of resilience as an adaptive resource that helps students recover from setbacks, tolerate uncertainty, and sustain goal-directed behavior under pressure. Thomas et al. (2023) described resilience among diagnostic radiography students in terms of adaptation and continuation despite stressors, while Thomas et al. (2025) showed that supportive interpersonal relationships within the clinical environment can strengthen students' capacity to cope. The present model extends that logic from description to prediction by quantifying the degree to which resilience explains variation in attrition-related thinking.

The magnitude of the association is also compatible with evidence from other health professions. Bakker et al. (2021) demonstrated that clinical learning conditions, especially co-worker support, can reduce intention to leave nursing education. This matters because resilience does not operate independently of context. A student may possess strong personal coping resources yet still struggle in an environment characterized by inconsistent supervision, excessive psychological demands, or hostile interactions. Conversely, a supportive clinical culture can provide external resources that help students interpret difficulty as manageable rather than as evidence that they do not belong in the profession. For Radiologic Technology programs, resilience surveillance should therefore trigger examination of both the student and the learning environment. It should not become a mechanism that assigns responsibility for attrition solely to individual weakness.

The year-level pattern provides additional context. Fourth-year students displayed the highest resilience and the lowest attrition propensity, while first-year students had the lowest resilience and the highest attrition propensity. This gradient is plausible because progression through a professional program brings repeated exposure to technical tasks, clinical communication, performance evaluation, and professional norms. Jeyandrabalan et al. (2022) found that radiography students' emotional well-being is shaped by adaptation to the reality of clinical practice, relationship formation, and the balance between learner status and patient-care responsibility. O'Connor et al. (2023) likewise observed that difficult clinical experiences can contribute to professional growth when adequate support is present. The present pattern may therefore reflect progressive mastery, accumulated coping experience, and stronger professional identity among senior students.

However, the adjusted regression indicates that year level itself contributed little after resilience was entered. This finding is important because it suggests that simple seniority may not be the mechanism that protects students from attrition. What appears to matter is the adaptive capacity that often develops across training. In practical terms, a first-year student with strong resilience may have lower attrition propensity than a more senior student with weaker coping resources. This supports direct assessment of resilience rather than reliance on year level as a proxy for readiness. It also provides a rationale for intervention early in the program, before students encounter the highest-stakes clinical environments.

Academic performance showed a modest inverse bivariate relationship with attrition propensity but did not remain statistically significant in the adjusted model. The result suggests that grades alone may be an incomplete retention indicator. Higher education research has repeatedly shown that dropout intentions reflect more than academic ability. Nemtcan et al. (2020) identified academic self-efficacy and social and academic integration as important pathways associated with attrition intentions. Buizza et al. (2024) similarly linked elevated dropout risk to relational and motivational factors. In Radiologic Technology, students may perform adequately on examinations yet still experience uncertainty about clinical fit, fear of error, emotional fatigue, financial pressure, or discomfort in hierarchical clinical settings. A retention system that uses only grades could therefore miss students who remain academically competent but psychologically disengaged.

This interpretation is especially relevant in the Philippine context, where academic and interpersonal stressors have been documented among Radiologic Technology students. Cruz et al. (2024) reported meaningful stress related to academic demands and interpersonal factors among students in

Iligan City. Such findings reinforce the value of a layered monitoring approach that combines academic performance with student-reported psychosocial indicators. Resilience is attractive for this purpose because it can be assessed briefly, repeated over time, and connected to specific supports such as mentoring, peer networks, clinical debriefing, workload planning, counseling referral, and structured preparation before placement.

The quality assurance framing strengthens the institutional relevance of the model. JRCERT requires radiography programs to maintain completion data and use program effectiveness evidence for ongoing improvement (JRCERT, 2021). The principle is not merely to publish outcomes but to analyze them, compare them with expected achievement, and document action when performance concerns appear. In the present model, the semester continuation rate of 96.3% sits above the JRCERT-reported radiography average annual completion rate of 89% for the referenced cycle (JRCERT, 2024). These figures are not directly comparable because one is a semester continuation estimate and the other is a full-program completion metric, yet the comparison demonstrates how an institution can situate local retention data within an external reference landscape while preserving methodological distinctions.

The ASRT curriculum and IAEA quality framework provide a second level of benchmarking. ASRT's Radiography Curriculum emphasizes a broad body of knowledge and professional preparation that includes patient care, radiation safety, imaging procedures, quality management, ethics, communication, and professional development (ASRT, 2022). The IAEA (2023) similarly treats competent personnel and continuous quality improvement as core parts of safe diagnostic radiology. Student persistence does not prove competence, but persistent attrition can weaken the educational pipeline through which competence is developed. For that reason, resilience and attrition surveillance can be viewed as upstream quality indicators. They are most valuable when combined with direct educational outcomes such as clinical competency assessment, radiation-safety performance, certification or licensure results, and graduate employment.

The predictive component should be interpreted with equal emphasis on usefulness and restraint. The model explained nearly half of the variance in attrition propensity, and bootstrap validation suggested only modest optimism. This is encouraging for a parsimonious institutional model, but it does not justify individual-level automated decision making. Riley et al. (2019) emphasize that prediction models require sufficient sample size relative to the number of parameters, while Steyerberg (2019) highlights the need for internal validation, external validation, and attention to calibration before clinical or operational use. The present cohort of 80 students is appropriate for an exploratory classroom and quality-improvement model with few predictors, but it is not adequate to establish a transportable risk algorithm across institutions.

Accordingly, the most defensible application is a tiered support process rather than a pass-fail risk label. Programs could measure resilience and attrition propensity at entry, before first substantial clinical exposure, and at transition points between year levels. Students with declining resilience or repeated attrition thoughts could be invited to a confidential academic and well-being review. The review should examine workload, finances, academic confidence, clinical supervision, interpersonal experiences, career fit, and access to support. Such a system respects the fact that dropout intention is dynamic. It also avoids converting a probabilistic model into a deterministic judgment about whether a student will leave.

A broader implication concerns educational culture. McNulty et al. (2025) documented persistent concerns among radiography students related to clinical preparedness, placement safety, communication, and institutional support, even as many students reported stronger professional identity and competence after difficult experiences. Thomas et al. (2025) likewise showed that interpersonal interactions can either enable or undermine resilience. Programs that wish to reduce attrition should therefore address the conditions under which resilience develops. Clear orientation, psychologically safe supervision, respectful feedback, protected opportunities for reflection, accessible faculty contact, and structured peer support are not peripheral welfare activities. They are mechanisms through which a demanding clinical curriculum can remain both rigorous and sustainable.

The findings also illustrate why global benchmarking should be used carefully in local research. International accreditation bodies and professional organizations provide valuable reference points, but direct transplantation of standards can be misleading when regulatory systems, program structures, degree lengths, and workforce pathways differ. The appropriate use of JRCERT, ASRT, and IAEA guidance in this study is therefore conceptual and comparative. JRCERT contributes a model for program-effectiveness surveillance, ASRT contributes expectations for educational preparation, and IAEA contributes a broader quality and safety framework. Local decision making should still be anchored in Philippine regulatory requirements, institutional mission, student characteristics, and the realities of clinical placement partnerships.

Overall, the analysis supports a shift from attrition as an end-of-year statistic to attrition as a preventable quality concern with identifiable antecedents. Resilience emerged as the most informative measured predictor, but the literature makes clear that resilience is shaped by relationships, workload, support, and the clinical learning environment. A high-quality retention strategy should therefore combine individual skill development with institutional quality improvement. The central value of predictive modeling lies not in identifying students to exclude, but in identifying moments when support can preserve learning, professional development, and eventual contribution to the medical imaging workforce.

V. LIMITATIONS

This study has several limitations that should shape how students interpret the findings. First, the cohort is limited to one Radiologic Technology program and only 80 students. The census provides complete institutional coverage but does not provide the sample size required for a transportable multivariable prediction model. The regression was therefore intentionally parsimonious and internally validated by bootstrap rather than presented as a deployable risk calculator. External validation in larger, multisite Philippine cohorts would be required before any individual prediction use.

Second, clinical attrition was represented primarily through a self-reported attrition-propensity scale rather than a large number of observed dropout events. Intention to leave is an important proximal indicator but is not identical to actual withdrawal. The semester continuation measure covered only January to May 2025 and cannot be equated with full-program completion. Third, resilience and attrition propensity were measured at one main survey point, which limits assessment of change over time. Repeated measures would clarify whether resilience rises with clinical exposure and whether changes in resilience precede changes in attrition thinking. Fourth, the adaptation of a general dropout-intention measure to Radiologic Technology requires further psychometric evaluation in independent samples, despite strong content-validity and reliability indices. Fifth, potentially important predictors such as financial strain, commuting burden, clinical-site climate, sleep, mental health, family responsibilities, and perceived supervisory support were not included to avoid overfitting. Future studies should examine these variables in adequately powered cohorts.

VI. CONCLUSION

The study indicates that occupational resilience may serve as a meaningful early-warning indicator of clinical attrition propensity among Radiologic Technology students. Across the complete 80-student program census, higher resilience was associated with substantially lower attrition propensity, and resilience remained the dominant predictor after adjustment for academic performance, year level, and sex. Senior students showed higher resilience and lower attrition propensity, but the adjusted model suggests that adaptive capacity itself may be more informative than year level alone.

For program quality assurance, resilience and attrition surveillance can complement established outcomes such as continuation, completion, licensure performance, clinical competence, and graduate employment. The appropriate institutional response is supportive rather than punitive: repeated screening, early mentoring, clinical debriefing, peer support, and systematic review of the learning environment. International standards from JRCERT, ASRT, and IAEA provide useful reference points for data-informed improvement, but local metrics should not be treated as direct evidence of accreditation equivalence. Larger multisite cohorts with longitudinal follow-up are needed to validate the model and determine whether resilience-focused interventions reduce actual attrition while preserving educational rigor and patient-safety standards.

Author Contributions

Ma. Victoria Patrimonio: Investigation, Data curation, Project administration, Writing – original draft. Ahemda Ali: Formal analysis, Validation, Visualization, Writing – review & editing. Mark Alipio: Conceptualization, Methodology, Supervision, Writing – review & editing. All authors have read and agreed to the published version of the manuscript.

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Ethics Approval and Informed Consent

The study was conducted in accordance with the ethical standards of the Declaration of Helsinki and approved by the Institutional Ethics Review Committee of Iligan Medical Center College. Written informed consent was obtained from all participating students prior to their inclusion in the study. All data were de-identified to ensure confidentiality, and it was explicitly communicated that participation was entirely voluntary and would not impact the students' academic standing or grades.

Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Deidentified data may be made available by the corresponding author upon reasonable request and subject to applicable ethics and institutional requirements.

Declaration of AI Use

During the preparation of this work, the authors utilized generative artificial intelligence technologies exclusively for language refinement, structural formatting, and copyediting. The AI system had no access to raw data and was not used to generate data, perform statistical analyses, or draw scientific conclusions. The authors independently reviewed, edited, and validated all content, and take full responsibility for the accuracy and integrity of the final publication.

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