DOI:10.31557/RRO.2026.12.1.77

ORIGINAL RESEARCH

Implementing a Brachytherapy Program in a Radiation Oncology Department in Vietnam: A Mixed-Methods Pre-Post Assessment of Staff Apprehension and Readiness

Basma Mbarek, Ha Thu Huynh Nguyen, Hariprasanth Karthikeyan, Vo Kim Dien, Thao Thi Phu Phuong Vo, Linh Nhat Vo, Xuan Thanh, Tin Pham Duc

FV Hospital, Thomson Group, Hy Vong Cancer Center, 6 Nguyen Luong Bang Street, Ho Chi Minh City, Vietnam.

Abstract

Introduction: To identify factors contributing to healthcare professionals' apprehension about the introduction of a new brachytherapy service and to evaluate changes in staff confidence and readiness following a structured implementation and training program. **Methods:** A pre–post implementation study was conducted among clinical and non-clinical staff involved in establishing a new brachytherapy service. Participants completed an anonymous questionnaire assessing perceived usefulness, readiness, and apprehension regarding brachytherapy implementation using 10-point numerical rating scales. Underlying concerns were explored through semi-structured interviews with open-ended questions, and qualitative responses were analyzed thematically. Following the development of standardized workflows, implementation of standard operating procedures (SOPs), and delivery of a comprehensive multidisciplinary training program, the same questionnaire and interviews were administered to the same participants. Quantitative scores and qualitative themes were compared before and after the intervention. **Results:** Twenty-three multidisciplinary team members participated in both assessments. Before training, the mean apprehension score was 8/10, while the mean readiness score was 3/10. Five major domains of concern were identified: radiation safety; limited knowledge and experience; workflow complexity and coordination; risk of procedural incidents, particularly source-retention events; and patient discomfort. Radiation safety was the most frequently reported concern, particularly among radiation therapists and members of their management teams. Following tailored training, workflow standardization, SOP implementation, and supervised initiation of clinical procedures, the mean apprehension score decreased by 3.2 points, while the mean readiness score increased to 7/10. Post-training assessments indicated greater confidence in radiation safety, improved understanding of the clinical benefits of brachytherapy, and increased motivation across professional groups. **Conclusion:** The introduction of a new brachytherapy service may be associated with substantial apprehension among healthcare professionals, particularly concerning radiation safety, technical complexity, and unfamiliar workflows. A structured implementation approach that incorporates early identification of staff concerns, clearly defined SOPs, standardized workflows, and tailored multidisciplinary training may improve staff readiness and facilitate the adoption of brachytherapy services.

Keywords: Brachytherapy, Healthcare professionals, Staff training, Radiation safety, Service implementation

Rep Radiother Oncol, **12 (1)**, 77-84

Submission Date: 07/14/2026 Acceptance Date: 09/01/2026

Introduction

Brachytherapy is an essential component of modern radiation oncology and is widely used in the management of several malignancies, including cervical, endometrial, prostate, breast, and selected skin cancers. By delivering a radioactive source directly within or adjacent to the target volume, brachytherapy enables highly conformal dose delivery with rapid dose fall-off, facilitating tumor dose escalation while limiting radiation exposure to surrounding normal tissues [1]. Its role is particularly important in cervical cancer, for which definitive treatment of locally advanced disease typically involves external beam radiotherapy (EBRT), concurrent chemotherapy,

Corresponding Author:
Dr. Basma Mbarek
FV Hospital, Thomson Group, Hy Vong Cancer Center, 6 Nguyen Luong Bang Street, Ho Chi Minh City, Vietnam.
Email: bes.mbarek@gmail.com

and brachytherapy to achieve optimal tumor control [2, 3].

Despite its established clinical benefits, access to brachytherapy remains uneven worldwide, particularly in low- and middle-income countries (LMICs), which bear a disproportionate burden of cervical cancer [4, 5]. Limited infrastructure, financial constraints, shortages of trained radiation oncology personnel, inadequate equipment maintenance, and insufficient opportunities for specialized training continue to hinder the development and sustainability of brachytherapy services [6-8]. In cervical cancer, these limitations may have important clinical consequences because omission or inadequate delivery of brachytherapy can compromise local control and survival compared with guideline-concordant treatment [6]. The increasing adoption of image-guided adaptive brachytherapy (IGABT) further emphasizes the need for appropriate infrastructure, technical expertise, quality assurance, and multidisciplinary coordination [9].

Vietnam illustrates the challenges associated with expanding access to advanced radiation oncology services. According to GLOBOCAN 2020 estimates, cervical cancer remains an important health concern among Vietnamese women, with an estimated incidence rate of 20.51 cases per 100,000 women and approximately 2,223 deaths annually [5]. Although radiotherapy capacity has expanded, access to specialized services remains uneven, with limitations in treatment capacity and availability of brachytherapy facilities reported in some regions [10]. These constraints highlight the need not only for investment in equipment and infrastructure but also for effective strategies to establish and sustain multidisciplinary brachytherapy services.

Establishing a new brachytherapy program is a complex organizational process that extends beyond the acquisition of treatment equipment. Successful implementation requires appropriately trained personnel, dedicated treatment facilities, quality assurance systems, standardized workflows, clear delineation of responsibilities, and sustained institutional support [11]. Previous reports have emphasized the importance of multidisciplinary collaboration and structured processes involving radiation oncologists, medical physicists, radiation therapists, anesthesiologists, nurses, and other healthcare professionals during the introduction of brachytherapy services and image-guided techniques [11, 12].

However, technical and infrastructural considerations alone may not adequately explain the challenges encountered during implementation. Healthcare professionals who are unfamiliar with brachytherapy may experience apprehension related to radiation exposure, technical complexity, procedural safety, unfamiliar workflows, patient management, and the potential consequences of procedural errors. Such concerns may influence staff confidence, willingness to participate, and readiness to adopt a new clinical service. Although implementation literature has extensively addressed organizational and technical requirements for establishing radiotherapy and brachytherapy services, less attention has been given to systematically assessing healthcare professionals' concerns during the initial implementation phase and evaluating whether targeted education and standardized processes can improve staff readiness.

Understanding these concerns is particularly relevant when introducing brachytherapy in settings where experience with the procedure is limited. Early identification of barriers may allow institutions to develop targeted training, standard operating procedures (SOPs), and multidisciplinary workflows before routine clinical implementation. Accordingly, the present study aimed to identify the factors underlying healthcare professionals' apprehension regarding the introduction of a new brachytherapy service and to assess changes in staff apprehension and readiness following a structured implementation strategy incorporating standardized workflows, SOPs, multidisciplinary training, and supervised initiation of clinical procedures.

Beyond technical and logistical barriers, human factors are important determinants of the successful implementation of new radiation technologies. The introduction of complex procedures often requires changes in established clinical workflows and professional practices, which may generate uncertainty and apprehension among healthcare professionals. In brachytherapy, concerns related to procedural complexity, radiation safety, limited experience, increased workload, and potential treatment-related complications may influence staff acceptance and readiness to adopt the technique [13]. Previous studies have identified inadequate training and limited confidence as important barriers to the establishment and sustainability of brachytherapy practice, emphasizing the need for structured competency-based education and supervised hands-on training [14, 15].

In our department, the implementation of a brachytherapy service was initiated as part of a broader technological development program aimed at expanding and improving radiation oncology services, with an initial focus on gynecological malignancies. The introduction of this new treatment modality raised concerns among members of the multidisciplinary team, particularly regarding radiation safety, procedural complexity, and unfamiliar clinical workflows. Recognizing that successful implementation requires attention to both technical requirements and human factors, we sought to explore the underlying concerns associated with brachytherapy adoption and to assess changes in staff readiness following a structured training and implementation strategy.

Materials and Methods

A baseline assessment was conducted among multidisciplinary clinical and non-clinical staff involved in the implementation of the new brachytherapy service. Information was collected regarding participants' professional roles, years of professional experience, and previous exposure to brachytherapy.

Shortly after the announcement of the brachytherapy implementation project, participants completed an anonymous written questionnaire assessing their perceptions, readiness, and apprehension regarding the

introduction of the new treatment modality. Semi-structured interviews using predefined open-ended questions were also conducted to explore participants' concerns in greater depth.

A total of 23 staff members participated in the assessment. The multidisciplinary team comprised radiation oncologists (n=3), medical physicists (n=3), dosimetrists (n=2), radiation therapists/radiographers (n=6), oncology nurses (n=5), mid-level managerial staff (n=2), and nurse navigators (n=1). Participants represented different levels of professional experience and clinical and managerial responsibilities within the brachytherapy implementation process.

The questionnaire consisted of three main domains designed to assess different aspects of the anticipated implementation process, including perceived usefulness of brachytherapy, readiness to adopt the new service, and apprehension regarding its implementation.

Participants rated their level of apprehension and readiness using numerical rating scales. Higher scores represented greater levels of the respective construct. The questionnaire was administered anonymously to encourage participants to report their concerns openly and to minimize potential response bias. The semi-structured interviews included predefined open-ended questions addressing participants' expectations and concerns regarding brachytherapy implementation. These questions explored potential sources of apprehension, including radiation safety, procedural complexity, previous experience, workflow and coordination, workload, patient-related concerns, and potential procedural complications.

Qualitative Analysis

Responses to the open-ended questions were analyzed using thematic analysis. Responses were reviewed and coded according to recurring concepts, which were subsequently grouped into broader themes representing the principal concerns associated with brachytherapy implementation. The qualitative findings were used to complement the questionnaire results and provide a more detailed understanding of the factors contributing to staff apprehension.

Following the baseline assessment, a structured implementation strategy was developed to address the concerns identified among staff members. The intervention included standardized clinical workflows, development and implementation of standard operating procedures (SOPs), multidisciplinary training, and supervised initiation of clinical procedures.

The training program was tailored to the professional roles and responsibilities of the participating staff. Training focused on radiation safety, brachytherapy procedures and workflows, role-specific responsibilities, multidisciplinary coordination, patient management, and prevention and management of potential procedural incidents. Particular emphasis was placed on practical training and supervised clinical experience to improve familiarity and confidence before routine implementation of the service.

After completion of the training program, implementation of the SOPs and standardized workflows, and supervised initiation of clinical procedures, the same questionnaire was administered to the same 23 participants. Semi-structured interviews were also repeated to assess changes in participants' concerns and perceptions. Pre- and post-training questionnaire scores were compared to evaluate changes in apprehension and readiness. Qualitative responses obtained after the intervention were analyzed thematically using the same approach applied to the baseline responses, allowing comparison of the major concerns identified before and after implementation of the training strategy.

The questionnaire comprised three domains. The first assessed participants' perceptions of the clinical value and relevance of establishing a brachytherapy service at the institution. Participants were asked to evaluate the usefulness of brachytherapy and the appropriateness of introducing the treatment modality within their clinical setting.

The second domain assessed perceived readiness to implement and participate in brachytherapy practice. Participants rated their readiness on a numerical rating scale from 0 to 10, with 0 indicating complete lack of readiness and 10 indicating full preparedness to participate in brachytherapy procedures. The third domain assessed apprehension regarding the implementation of brachytherapy. Apprehension was rated on a 0–10 numerical rating scale, with 0 indicating no apprehension or concern and 10 indicating extreme apprehension associated with the complexity or perceived risks of the new technique.

In addition to the numerical ratings, participants were invited to provide free-text responses describing factors contributing to their perceived lack of readiness or apprehension regarding brachytherapy implementation. These qualitative responses were used to identify perceived barriers, educational needs, and sources of uncertainty among members of the multidisciplinary team.

Training and Implementation Intervention

Following the baseline assessment, a structured preparatory and training program was implemented. The same questionnaire and interview procedures were subsequently repeated with the same participants after completion of the preparatory phase. The post-intervention assessment was conducted after validation and dissemination of internally developed clinical workflows and standard operating procedures (SOPs), as well as completion of the planned educational and practical training activities.

The training program comprised several complementary components, including in-house multidisciplinary educational sessions, technical training provided by the equipment manufacturer or vendor, and observational and hands-on training visits to established brachytherapy centers. The training incorporated both theoretical and practical components. The educational curriculum covered the principles and clinical indications of brachytherapy, treatment workflows, radiation safety, quality assurance,

emergency management, treatment-planning principles, and practical simulation exercises.

Data Analysis

Quantitative questionnaire data were summarized descriptively using frequencies, percentages, and mean scores, as appropriate. Pre- and post-intervention scores for readiness and apprehension were compared descriptively because of the small sample size. Qualitative data obtained from the semi-structured interviews and free-text questionnaire responses were analyzed using thematic analysis. The analysis focused on identifying recurring themes related to perceived barriers, sources of apprehension, training needs, and factors facilitating successful implementation. All completed questionnaires were reviewed for completeness, and all available responses were included in the analysis.

Results

Before initiation of the training program, participants demonstrated substantial apprehension regarding the implementation of brachytherapy. Readiness scores ranged from 0 to 5 on the 0–10 scale, with a mean score of 3/10. In contrast, apprehension scores were consistently high, with reported scores of ≥7/10 and a mean score of 8/10. Overall, apprehension appeared to be more pronounced among clinical staff than among non-clinical personnel.

Thematic analysis of the baseline interviews and free-text responses identified five major domains of concern: (1) radiation safety; (2) limited knowledge and previous experience; (3) complexity of the brachytherapy workflow and multidisciplinary coordination; (4) the risk of procedural incidents, particularly unintended source retention or failure of source retraction; and (5) concerns regarding patient discomfort and pain during treatment.

Radiation safety was the most frequently reported concern. Participants expressed apprehension regarding potential occupational radiation exposure during brachytherapy procedures and the possibility of accidental exposure associated with source-related incidents. These concerns were particularly prominent among radiation therapists and managerial staff responsible for their supervision.

Qualitative responses also indicated that some concerns were associated with participants' previous professional exposure to manually operated low-dose-rate (LDR) brachytherapy systems. In particular, participants who had previously encountered LDR systems expressed concerns about radiation exposure that did not necessarily reflect the operating principles of the remote afterloading system being introduced at the institution. The transition from manually operated LDR techniques to high-dose-rate (HDR) remote afterloading technology, in which the radioactive source is automatically transferred from a shielded source container to the applicator and retracted following treatment, was not initially fully understood by all participants. This finding highlighted the importance of technology-specific education and practical demonstration during the implementation process.

Changes in Staff Concerns Following the Training Intervention

The second major source of apprehension was limited knowledge and insufficient practical experience with brachytherapy procedures. This concern was particularly evident among radiation oncologists, medical physicists, and dosimetrists. Among radiation oncologists, uncertainty primarily involved the technical aspects of brachytherapy delivery, particularly interstitial techniques, which were perceived as complex procedures requiring specialized expertise. Medical physicists and dosimetrists reported concerns across several stages of the brachytherapy workflow, including source calibration, quality assurance, applicator reconstruction and modeling, treatment planning, and dose optimization.

The third major domain of concern involved workflow complexity and the anticipated need for intensive multidisciplinary coordination. Participants expressed uncertainty regarding patient pathways, communication between professional groups, allocation of responsibilities, and the potential increase in workload. Concerns regarding staffing capacity and additional responsibilities were reported by both clinical and non-clinical personnel.

The fourth domain concerned radiation source-related emergencies, particularly failure of source retraction during HDR brachytherapy procedures. The possibility of an unintended source-retention event, referred to by participants as a "stuck source" event, was a major source of apprehension, particularly among personnel directly involved in treatment delivery. The fifth domain involved patient-related concerns. Non-clinical staff in particular perceived brachytherapy as an invasive and potentially stressful procedure and expressed concerns regarding patient pain, discomfort, anxiety, and psychological distress associated with applicator insertion and treatment delivery.

Following completion of the structured training program, validation and dissemination of SOPs, and supervised performance of the initial brachytherapy procedures with experienced mentors, the same assessment was repeated. The post-intervention assessment demonstrated a marked reduction in reported apprehension and an increase in perceived readiness and confidence across the multidisciplinary team. These changes were particularly evident among radiation therapists and their direct managerial teams.

A notable change was observed in perceptions of radiation safety. Before training, the potential for occupational radiation exposure was the predominant concern among radiation therapists. Following training and practical exposure to the HDR remote afterloading workflow, radiation exposure was less frequently reported as a major barrier to implementation. Instead, radiation safety and emergency preparedness were increasingly viewed as ongoing professional responsibilities, particularly by medical physicists and dosimetrists. Participants described greater familiarity with emergency

preparedness procedures, including stuck-source management protocols and simulation drills developed as part of the SOPs.

Participants also emphasized the safety advantages of modern HDR remote afterloading systems, particularly the automated transfer and retraction of the radioactive source, which avoids direct manual handling of the source during routine treatment. Among radiation therapists, concerns regarding unintended patient overdose were also less prominent after training. Following the intervention, this concern was increasingly framed as an aspect of treatment safety and quality assurance requiring continuous monitoring, particularly by radiation oncologists.

Overall, the qualitative findings indicated a shift in staff perceptions from generalized apprehension about radiation exposure and unfamiliarity with the technology toward a more structured understanding of radiation safety, emergency preparedness, treatment quality assurance, and role-specific responsibilities within the brachytherapy workflow.

Changes in Perceived Clinical Value and Patient-Centered Perspectives

Before training, the clinical value of brachytherapy and its potential contribution to patient outcomes were primarily emphasized by radiation oncologists. Following completion of the training program, radiation oncologists continued to recognize the essential role of brachytherapy in cervical cancer management while also reporting broader awareness of its potential applications in other malignancies, including prostate and rectal cancers. Training visits to experienced brachytherapy centers were repeatedly identified by participants as an important component of the preparation process and were perceived as contributing to increased familiarity with the technique and greater confidence in its implementation.

Among other professional groups, including radiation therapists, nurses, and non-clinical staff, post-training interviews demonstrated a shift toward greater recognition of the potential benefits of brachytherapy for patients and increased professional motivation. Whereas baseline responses focused predominantly on perceived risks and practical difficulties, post-training responses more frequently emphasized the therapeutic value of the treatment. Recurring themes included safe and effective treatment, patient benefit, and the importance of timely treatment delivery. These findings suggest that structured education may enhance not only technical familiarity but also understanding of the clinical purpose and patient-centered value of a newly introduced service.

An additional theme identified after training among nurses and radiation therapists was the importance of maintaining patient dignity and privacy during brachytherapy procedures. This issue was not prominent in the baseline assessment but emerged more frequently after participants had gained greater understanding of the patient pathway and procedural requirements. This finding underscores the importance of incorporating psychosocial, privacy, dignity, and patient-centered considerations into multidisciplinary brachytherapy training.

Quantitative Changes in Readiness and Apprehension

Following completion of the training program and supervised initiation of clinical practice, participants reported an increase in readiness to implement brachytherapy. The mean readiness score increased from 3/10 at baseline to 7/10 after the intervention, with post-training scores ranging from 5 to 9/10. This represented an average increase of 4 points. In parallel, the mean apprehension score decreased by 3.2 points following the intervention.

Taken together, the quantitative and qualitative findings indicate that the structured implementation strategy was associated with improved perceived readiness and reduced apprehension among the participating multidisciplinary team. The qualitative findings further suggest that the change involved a shift from generalized concerns about radiation exposure, unfamiliarity, and procedural complexity toward greater understanding of role-specific responsibilities, patient benefits, safety procedures, and quality assurance requirements.

Discussion

The present study explored healthcare professionals' apprehension and readiness during the introduction of a new brachytherapy service and examined changes following a structured implementation and training strategy. The findings indicate that establishing a brachytherapy program involves challenges that extend beyond equipment acquisition and technical infrastructure. Before implementation, staff concerns centered primarily on radiation safety, limited knowledge and experience, workflow complexity, potential source-related emergencies, and patient discomfort. Following multidisciplinary training, workflow standardization, SOP implementation, and supervised clinical initiation, apprehension decreased and perceived readiness increased.

These findings highlight the importance of addressing human factors during the implementation of complex radiation oncology technologies. A new brachytherapy service requires healthcare professionals to acquire new technical knowledge while simultaneously adapting to unfamiliar workflows, responsibilities, communication pathways, and safety procedures. Without adequate preparation, these changes may contribute to uncertainty and reluctance to participate in the new service. Conversely, structured education and practical exposure may help transform unfamiliarity into greater procedural understanding and role-specific confidence.

The findings are consistent with International Atomic Energy Agency (IAEA) recommendations emphasizing that the implementation of HDR brachytherapy requires coordinated preparation of infrastructure, trained multidisciplinary personnel, quality assurance systems, emergency preparedness, and continuing education [8]. In the present study, a dedicated implementation team was established to coordinate the preparatory process, develop and validate clinical workflows, facilitate staff training, and ensure that clinical, technical, and safety requirements were addressed before routine clinical implementation.

This multidisciplinary approach is particularly relevant when establishing a new service because the safety and effectiveness of brachytherapy depend on coordinated performance across multiple professional groups rather than on the expertise of a single discipline.

An important finding was that radiation safety represented the dominant source of apprehension before training. Radiation therapists and their managerial teams expressed particular concern about occupational exposure and potential source-related incidents. These concerns are understandable when staff have limited experience with HDR remote afterloading systems, particularly when previous professional exposure has involved different brachytherapy technologies. Following training and supervised clinical exposure, however, radiation safety was less frequently perceived as a barrier and was increasingly understood as an ongoing professional responsibility. This change suggests that technology-specific education, practical demonstration, and simulation of emergency procedures may be particularly valuable during implementation.

The distinction between apprehension about radiation safety and professional responsibility for radiation safety is important. The objective of implementation training should not be to eliminate concern about radiation exposure, because appropriate vigilance is fundamental to radiation protection. Rather, effective training should enable staff to distinguish realistic risks from misconceptions and to understand the engineering, procedural, and organizational controls used to manage those risks. In this context, the observed shift toward greater emphasis on emergency preparedness and quality assurance may represent a more meaningful implementation outcome than simply a reduction in reported anxiety.

Another important finding concerned the role of hands-on and observational training. Participants repeatedly identified training visits to established brachytherapy centers as particularly valuable. Direct observation of experienced teams may provide forms of experiential learning that cannot be fully achieved through theoretical instruction alone. Such exposure allows staff to observe patient flow, professional role allocation, treatment preparation, radiation-safety practices, emergency procedures, and multidisciplinary communication within an operational service. For institutions introducing brachytherapy for the first time, collaboration with experienced centers may therefore provide a practical mechanism for accelerating organizational learning and reducing uncertainty.

The increase in perceived readiness from a mean of 3/10 to 7/10 further supports the potential value of a multimodal implementation strategy. Importantly, the intervention did not consist of training alone. It combined needs assessment, multidisciplinary education, vendor-based technical training, external observational and hands-on exposure, standardized workflows, SOP development, and supervised clinical initiation. The improvement in readiness should therefore be interpreted as an outcome associated with the combined implementation strategy, rather than attributed to any single component.

The qualitative findings also demonstrated an important change in how participants perceived the clinical purpose of brachytherapy. Before training, concerns about radiation exposure, procedural complexity, and patient discomfort were prominent among several professional groups. After training, participants more frequently emphasized treatment effectiveness, patient benefit, and the importance of timely treatment delivery. This shift is relevant to implementation because acceptance of a new technology may depend not only on whether staff understand how to perform the procedure safely, but also on whether they understand why the procedure is clinically important. Connecting technical training with patient outcomes may therefore strengthen professional engagement and motivation.

The emergence of patient dignity and privacy as a post-training theme is another noteworthy finding. Brachytherapy procedures, particularly gynecological procedures, involve intimate examinations and invasive applicator placement and may be associated with discomfort and psychological distress. The increased attention to dignity and privacy after training suggests that greater procedural knowledge may broaden staff awareness of the patient experience. Training programs should therefore address not only technical and safety competencies but also communication, privacy, dignity, pain management, and other patient-centered aspects of care.

Overall, the findings support an implementation model in which technical preparation and human-resource preparation are addressed concurrently. Establishing equipment and treatment infrastructure without adequately preparing the multidisciplinary workforce may leave important barriers unresolved. Conversely, early assessment of staff concerns can inform targeted education, while SOPs, standardized workflows, simulation exercises, and supervised clinical practice can translate knowledge into operational readiness. This approach may be particularly valuable in institutions with limited previous experience in brachytherapy.

The introduction of a new brachytherapy service was expected to generate some degree of reluctance and apprehension among healthcare professionals because of the changes in clinical workflows, responsibilities, and safety requirements associated with the new technology. Rather than treating these reactions solely as barriers, the implementation team incorporated systematic assessment of staff concerns into the implementation process. A structured questionnaire and semi-structured interviews were used to identify the sources of apprehension and to inform targeted educational and organizational interventions.

Resistance to change has been described as an individual response to perceived threats to established practices and the status quo [9]. In healthcare settings, resistance may arise from uncertainty, concerns about professional competence, disruption of established workflows, communication gaps, increased responsibilities, and perceived risks associated with new practices [9, 10].

If not recognized and addressed, such concerns may hinder the adoption and sustainability of organizational changes. In the present study, the assessment of apprehension provided an opportunity to identify specific concerns before routine clinical implementation and to incorporate these concerns into the preparation process.

Evidence from healthcare change-management literature suggests that implementation is more likely to be successful when healthcare professionals are actively engaged, their concerns are acknowledged, and they receive appropriate preparation and opportunities to contribute to the development of new practices [9, 10]. From this perspective, staff concerns can serve as an important source of information about potential weaknesses in an implementation plan rather than being viewed solely as resistance. This participatory approach is particularly relevant to brachytherapy, in which safe treatment delivery depends on coordinated performance across multiple professional groups, including radiation oncologists, medical physicists, radiation therapists, nurses, anesthesia personnel, and administrative staff.

In the present study, baseline concerns directly informed the content and delivery of the training program. Radiation safety was the most frequently reported source of apprehension; consequently, additional training was provided on radiation protection principles, emergency preparedness, and management of potential source-related incidents. Practical simulation exercises addressing source-retention emergencies were incorporated to familiarize staff with the appropriate response to rare but potentially serious events. Additional education covered personal dosimetry, radiation-controlled areas and signage, occupational radiation protection, and role-specific responsibilities during brachytherapy procedures. The radiation safety officer was also involved more extensively in the training program than initially planned in response to staff concerns.

The educational strategy was further adapted according to participant feedback. Audio-visual materials were developed and incorporated into the training and supporting documentation after participants identified video-based instruction as particularly useful for understanding radiation safety procedures and emergency responses. This adaptive approach allowed the training program to address both identified knowledge gaps and specific sources of apprehension rather than relying solely on a standardized curriculum.

These findings are consistent with previous reports indicating that structured, hands-on training tailored to baseline concerns can improve confidence and facilitate the implementation of image-guided brachytherapy among radiation oncologists, medical physicists, radiation technologists, and nursing personnel [11]. The present findings extend this concept by suggesting that training should be responsive to the concerns identified during the pre-implementation phase. In particular, combining theoretical education with simulation, practical demonstrations, external observational exposure, and supervised clinical practice may provide a more comprehensive approach to preparing multidisciplinary teams for the introduction of a new brachytherapy service.

Importantly, the goal of implementation training should not be to eliminate concern about radiation safety or procedural risk. Appropriate concern is an essential component of a strong safety culture. Rather, effective implementation should transform nonspecific apprehension into informed awareness of hazards, clearly defined responsibilities, and appropriate responses to potential incidents. In this study, the post-training shift from generalized concerns about radiation exposure toward greater emphasis on emergency preparedness, quality assurance, and role-specific safety responsibilities suggests that the intervention may have contributed to this transition.

The importance of structured training is supported by previous surveys indicating that inadequate education and limited procedural exposure remain important barriers to the wider adoption of brachytherapy. Radiation oncologists have reported limited confidence in performing complex procedures, particularly interstitial brachytherapy, in settings where opportunities for supervised practical training are limited [12]. In the present study, interstitial brachytherapy was similarly perceived as technically demanding and requiring specialized knowledge and competency-based training. These findings are consistent with international reports suggesting that limited access to standardized curricula and practical training opportunities may contribute to insufficient confidence among radiation oncology trainees and practicing clinicians.

Clear SOPs and documented workflows were also highly valued by participants, particularly clinical managers and mid-level leadership. These documents clarified professional roles and responsibilities, reduced uncertainty, and provided a common framework for multidisciplinary collaboration. For radiation therapists and medical physicists, practical exercises, simulation-based training, drills, and dry runs were considered particularly useful because they provided opportunities to rehearse complex processes before patient treatment.

Standardized procedures are important components of safety systems in high-risk healthcare environments because they can reduce unwanted variation, clarify responsibilities, and facilitate consistent communication. The World Health Organization's High 5s initiative has emphasized standardization and the use of structured processes as strategies for improving patient safety and reducing preventable errors [13]. In brachytherapy, where clinical decision-making, applicator placement, treatment planning, radiation protection, quality assurance, and emergency response are closely interconnected, clearly documented workflows and SOPs may be particularly valuable [14].

The findings of the present study therefore support a systematic, needs-based approach to brachytherapy implementation. Assessment of staff concerns before clinical introduction can identify specific knowledge gaps, perceived risks, and operational uncertainties that may otherwise remain unrecognized. These findings can then be used to tailor educational activities, prioritize resource

allocation, refine workflows, and develop appropriate SOPs before routine clinical practice begins. In this context, multidisciplinary training, standardized workflows, practical simulation, and supervised clinical initiation should be considered complementary components of an implementation strategy rather than isolated interventions.

Importantly, the observed reduction in apprehension should be interpreted in the context of the combined implementation strategy. Because the study did not include a control group and the sample size was small, the findings do not establish that any individual intervention component independently caused the observed changes. Nevertheless, the convergence of quantitative and qualitative findings suggests that systematic preparation and active engagement of healthcare professionals may facilitate readiness for the introduction of a new brachytherapy service.

Acknowledgements

The authors thank all healthcare professionals who participated in the questionnaire and interviews and contributed their time and perspectives to the implementation process.

Funding

This research received no external funding.

Ethical Approval

The study was approved by the Ethics Committee of [Hospital/Institution name], an ethics committee recognized by the Ministry of Health of Vietnam. All participants were informed about the purpose of the study and participated voluntarily. Questionnaire responses were collected anonymously.

Scientific Approval

No separate scientific approval was required for this study.

References

1. Viswanathan AN, Erickson B, Gaffney DK, Beriwal S, Bhatia SK, Burnett OL, et al. The quality of cervical cancer brachytherapy: A review of evidence and recommendations. Int J Radiat Oncol Biol Phys. 2012;82(3):1061-1070. doi.org
2. Sturdza A, Pötter R, Fokdal LU, Haie-Meder C, Tan LT, Mazeron R, Petric P, et al. Image guided brachytherapy in locally advanced cervical cancer: Improved pelvic control and survival in RetroEMBRACE, a multicenter cohort study. Radiother Oncol. 2016;120(3):428-433. https://doi.org/10.1016/j.radonc.2016.03.011
3. Pötter R, Tanderup K, Schmid MP, Jürgenliemk-Schulz I, Haie-Meder C, Fokdal LU, Sturdza AE, et al. MRI-guided adaptive brachytherapy in locally advanced cervical cancer (EMBRACE-I): a multicentre prospective cohort study. Lancet Oncol. 2021;22(4):538-547. https://doi.org/10.1016/S1470-2045(20)30753-1
4. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Cancer Statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021;71(3):209-249. https://doi.org/10.3322/caac.21660
5. Singh D, Vignat J, Lorenzoni V, Eslahi M, Ginsburg O, Lauby-Secretan B, Arbyn M, et al. Global estimates of incidence and mortality of cervical cancer in 2020: a baseline analysis of the WHO Global Cervical Cancer Elimination Initiative. Lancet Glob Health. 2023;11(2):e197-e206. https://doi.org/10.1016/S2214-109X(22)00501-0
6. Han K, Milosevic M, Fyles A, Pintilie M, Viswanathan AN. Trends in the utilization of brachytherapy in cervical cancer in the United States. Int J Radiat Oncol Biol Phys. 2013;87(1):111-119. https://doi.org/10.1016/j.ijrobp.2013.05.033
7. Grover S, Longo J, Einck J, Puri P, Brown D, Chino J, Mahantshetty U, et al. The unique issues with brachytherapy in low- and middle-income countries. Semin Radiat Oncol. 2017;27(2):136-142. https://doi.org/10.1016/j.semradonc.2016.11.005
8. Rodin D, Burger EA, Atun R, Barton M, Gospodarowicz M, Grover S, Hanna TP, et al. Scale-up of radiotherapy for cervical cancer in the era of human papillomavirus vaccination in low-income and middle-income countries: a model-based analysis of need and economic impact. Lancet Oncol. 2019;20(7):915-923. https://doi.org/10.1016/S1470-2045(19)30308-0
9. Pötter R, Tanderup K, Kirisits C, de Leeuw A, Kirchheiner K, Nout R, Tan LT, et al. The EMBRACE II study: the outcome and prospect of two decades of evolution within the GEC-ESTRO GYN working group and the EMBRACE studies. Clin Transl Radiat Oncol. 2018;9:48-60. https://doi.org/10.1016/j.ctro.2018.01.001
10. Phan NTH, Tran QT, Nguyen NPT, Nguyen HT, Tran LDN, Pham VC, Bennett K, et al. Closing the gap for cervical cancer research in Vietnam: current perspectives and future opportunities: a report from the 5th Gynecologic Cancer InterGroup (GCIG) Cervical Cancer Research Network (CCRN) Education Symposium. J Gynecol Oncol. 2023;34(5):e88. https://doi.org/10.3802/jgo.2023.34.e88
11. Scanderbeg DJ, Yashar C, Ouhib Z, Jhingran A, Einck J. Development, implementation, and associated challenges of a new HDR brachytherapy program. Brachytherapy. 2020;19(6):874-880. https://doi.org/10.1016/j.brachy.2020.08.018
12. Harkenrider MM, Shea SM, Wood AM, Chinsky B, Bajaj A, Mysz M, Yacoub JH, et al. How one institution overcame the challenges to start an MRI-based brachytherapy program for cervical cancer. J Contemp Brachytherapy. 2017;9(2):177-186. https://doi.org/10.5114/jcb.2017.66892
13. Lichter K, Akinfenwa CA, MacDuffie E, Bhatia R, Small C, Croke J, Small W Jr, et al. Treatment of cervical cancer: overcoming challenges in access to brachytherapy. Expert Rev Anticancer Ther. 2022;22(4):353-359. https://doi.org/10.1080/14737140.2022.2047936
14. Zhao S, Francis L, Todor D, Fields EC. Proficiency-based cervical cancer brachytherapy training. Brachytherapy. 2018;17(4):653-659. https://doi.org/10.1016/j.brachy.2018.03.001
15. Tan LT, Tanderup K, Kirisits C, Mahantshetty U, Swamidas J, Jürgenliemk-Schulz I, Lindegaard J, et al. Education and training for image-guided adaptive brachytherapy for cervix cancer-The (GEC)-ESTRO/EMBRACE perspective. Brachytherapy. 2020;19(6):827-836. https://doi.org/10.1016/j.brachy.2020.06.012