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Research article

The implementation of an advanced practice radiation therapy (APRT) program in Singapore



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ABSTRACT

Background: The exploration of Advanced Practiced Radiation Therapists (APRTs) development in Singapore started in 2011. This study aims to provide an overview of the development of the APRT roles, and to discuss the approaches used to develop and implement these roles in Singapore.

Materials and methods: A mixed methods approach was used in the development of the APRT program. A literature review was carried out to define the APRT scope of practice and core responsibilities. A competency and assessment framework were setup to assess the core competency areas. With this framework, a structured 1-year residency training program was developed.

Results: The scope of practice and core responsibilities of APRTs were defined with five proposed advanced practice profiles being successfully validated. A competency framework was set up to assess the core competency domains: clinical, technical and professional competencies, research, education and leadership. A 4-point scoring system was developed for the competency assessment based on two criteria; the frequency with which RTTs would demonstrate competency, and the ability of performing the task competently. A 1-year structured APRT residency program was developed and implemented. The programme consisted of structured lectures, and clinical practice-based modules where APRT residents receive structured mentoring under a mentorship program.

Conclusion: The APRT program in Singapore employed an evidence-based implementation process that tested the feasibility of a new practice model. Multidisciplinary involvements, mentorship and clinical training were important factors for the success of the APRT program.

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Introduction

An Advanced Practice Radiation Therapist (APRT) is an expert in a specific area of practice with responsibility to lead and develop staff and services through active involvement in research and contribution to the evidence base within their field [1–3]. Working closely with the multi-disciplinary teams, the APRT has in-depth knowledge of clinical assessment, available technology, treatment planning and delivery, and patient support in radiation therapy.

The interest in the development of APRT initiatives in Singapore started in 2011. The perception of APRT roles and the service needs in Singapore were derived from two institution wide study by Lim et al [4] and Shi et al [5]. Clinicians' and radiation therapists' (RTT) perceptions on site specific advanced practice roles and RTTs- led treatment reviews in Singapore were evaluated and the results supporting APRT development in Singapore were encouraging. Benefits of APRT include enhanced workflow efficiency, improvement in the professional knowledge of the RTTs, creating a clinical career progression pathway, promoting inter-professional communication, collaboration in clinical care and enhancing service quality with a patient-centered care delivery [4]. Role development

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was also seen to increase job satisfaction and in turn reduce staff turnover rate.

In 2012, a new model of care was piloted in Singapore that expands the role of radiation therapists to improve access and treatment quality for patients requiring radiation therapy. The first institution in Singapore to embark on this development was National Cancer Centre Singapore (NCCS), the biggest radiation oncology center in Singapore. 5 tumor sub site domains i.e. Breast, Head and Neck (H&N), Gynecological, Palliative and Lung disease specific site specializations were identified for development of APRT roles in the NCCS based on service needs. Interest in establishing APRT roles continued to grow and was expanded to other cancer centers in Singapore.

This article aims to provide an overview of the development of the APRT roles across Singapore’s cancer centers, learning from lessons derived from the Clinical Specialist Radiation Therapist (CSRT) project in Ontario [6]. This article also discusses the approaches used to develop and implement advanced practice (AP) roles, the competency and training framework and the use of an evidence-based approach to evaluate these positions [7–9].

Methods

A mixed methods approach was used in the development of the APRT program. The approach was divided into following key areas

1. Role development and scope of practice
2. Development of competency and assessment framework
3. APRT residency training program

Role development and scope of practice

A literature search was first undertaken to create a definition and understanding of what AP meant. The role of the APRT is clinically driven, focusing on the application of practical skill, underpinned by appropriate theoretical knowledge, to provide an effective service with due consideration for patient care[9]. A competency profile was next developed that described the expanded scope of practice assigned to the APRT. In general, the expanded scope included activities that were traditionally performed by Radiation Oncologists (RO). The acquisition of the various competencies by those engaged in the initial study was assessed such that when suitable competence was acquired, those activities could be

shared or delegated to the APRT to improve efficiency or effectiveness of the RT program.

The process of implementing APRT positions utilized the Participative, Evidence, Patient focused process PEPPA framework [10] The PEPPA framework (Fig. 1) is a conceptual framework that supports systematic planning and implementation of a service delivery improvement process such as the role of AP clinicians. Although the framework was initially developed to implement advanced nursing positions, it has been successfully used for APRTs [11–13].

Development of competency and assessment framework

The specific knowledge, skills and competencies necessary to operate at the practitioner level have been identified by several authors [13,14]. Minimum standards to be achieved include aspects of leadership, decision making, teaching, research and within the clinical environment, a significant contribution to patient management. An APRT competency and assessment framework adopted from Cancer Care Ontario (CSRT sustainability project) [6] and SingHealth College of Allied Health Residency was developed in 2018. This framework provided the structure for the development of an APRT residency training program.

The performance of both the APRTs and the impact that these positions have in the program or service requires regular monitoring. It should be reviewed on a regular basis and acted upon as and when evolution or modification of the position is found to be required [6]. Metrics for the studies were drawn from literature [6,11,12], where possible and developed de novo when no validated tool existed (3-point Likert scale for RO to assess concordance and impact of APRT decisions).

APRT residency training program

Lack of formalized skill development and training programs specific to APRT was one of identified challenges recognized in many studies [4,14,15]. The education required will need to move beyond traditional clinical reasoning to encompass collaborative practice, leadership and interpersonal skills [16]. A structured formalized 1-year APRT residency training program was thus developed to address this need. A recent benchmarking guideline on competency requirements for RTTs was released by the European Society of Radiotherapy and Oncology [17] and was used to assist the development of the APRT residency curriculum. This comprehensively described the knowledge and skill framework required

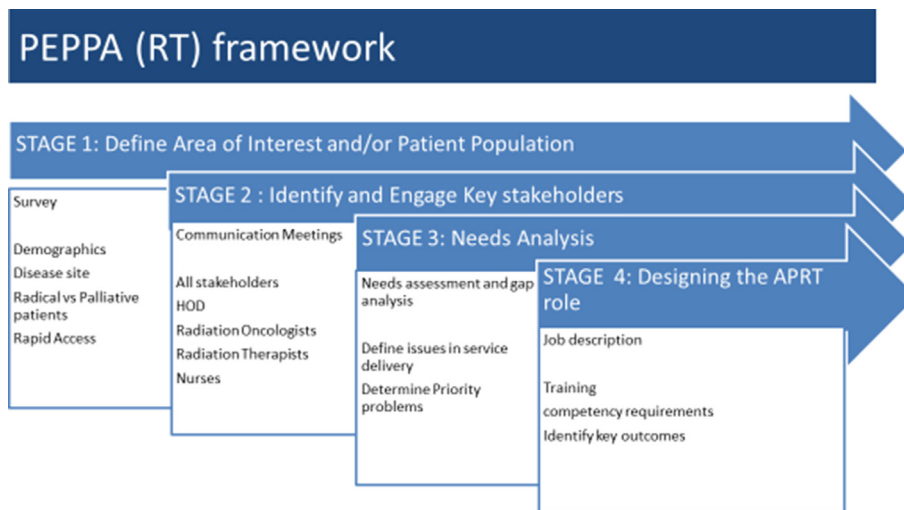


Fig. 1. PEPPA (RT) Framework [6].

at different levels of AP and provided a common understanding on the levels of recognition in terms of the required academic and professional competencies.

Prior to start of the training program, role mentors, typically radiation oncologists were identified. Each APRT were paired with a RO supervisor to identify and work towards learning goals. APRTs used a variety of methods to develop competence including self-directed learning, formal courses, one-on one supervision from members of the RT team. Once it was felt the APRT had achieved competence, concordance studies were employed to compare APRT performance with the gold standard performance. Activities assessed included, for example, on treatment review, new patient assessment and decision to treat, serving as expert technical consultants, image approval, contouring high risk target volumes and delineating treatment fields.

Results

A scope of practice and core responsibilities were defined (Table 1). Five proposed advanced practice profiles were successfully validated in Singapore with additional profiles i.e. Treatment planning specialist and Pediatric care under development.

APRT competency and assessment framework

A competency and assessment framework (Table 2 and Table 3) was set up to assess the core competency domains: Clinical, Technical and professional competencies, research, education and leadership. These were based on disease site or technical specialty, focusing on the knowledge and skills traversing all areas; such as ‘assessment of the patient’s physical condition’, ‘and ‘leading the ongoing development of best professional practices using evidence-based approaches’.

A 4-point system was developed for the competencies based on two criteria; the frequency with which RTTs would demonstrate competency, and the ability of performing the task competently.

APRT residency training program

Education and training are essential to ensure the competency of APRTs in this area. A 1-year structured APRT residency program was developed and implemented in Singapore (Fig. 2). The residency curriculum is outcome based and structured into 2 main components

- A. Structured modules and/or didactic lectures
- B. Clinical practice-based modules where APRT residents receive structured mentoring under a mentorship program.

The formal residency training program provided structure to guide performance, education and evaluation. Important to note that multidisciplinary involvement in training development and inclusion of summative competency assessment were important factors to support APRT development.

A three-phased certification process was chosen to ensure a comprehensive AP certification process: Phase 1: professional portfolio, Phase 2: patient case log, Phase 3: Objective Structured Clinical Examination (OSCE). Each candidate had an APRT program director and mentor to facilitate navigation. Mentor was typically a RO who provided thorough and extensive advanced clinical and

Table 1
Scope of Practice.

Defining Scope of Practice	
<p>The Advance Practice Radiation Therapist (APRT) is a highly competent clinical and academic practitioner with advanced knowledge, skills and judgement in specialized area of practice. The APRT will function within the multi-disciplinary sub site group to provide comprehensive, holistic care to patients during the course of their radiation therapy treatment by complementing and supplementing supportive care provided by the core team in accordance with the scope of practice, medical directives/protocols and practice guidelines</p>	
Clinical Competencies	<ol style="list-style-type: none"> 1. Develop and implement comprehensive care plans, which encompass the treatment process from time of consultation to planning, including follow up 2. Provide technical and dosimetric consultation at all phases of the radiation therapy planning and treatment process. 3. Consultation with assigned patients. Clinically assess patient physical and psychological status and manage radiation side effects during a course of radiation therapy, including appropriate documentation of findings 4. Establish strong relationships with relevant site groups and participate in weekly audits/tumor board activities to ensure effective communication between the interdisciplinary health care team and consistent delivery of care to the radiotherapy patient 5. Function as expert role model in radiation therapy best practices
Technical competencies	<ol style="list-style-type: none"> 1. Uses technical knowledge during assessment of patients for consideration of comfortable positioning and technical feasibility 2. Accurately locating and delineating treatment volumes and critical organs at risk on the planning CT scans in the treatment planning system 3. Performs virtual simulation and treatment planning of complex cases that are referred from the oncologist 4. Oversees treatment of complex cases 5. Utilize technique and dosimetric knowledge to review patient progress and provide information to patient on treatment process 6. Reviews and approves treatment verification images
Education: To lead in the development of	<ol style="list-style-type: none"> 1. Education and training programs and competencies for all staff in the area of specialized treatments 2. Patient education material for patients 3. Standards/protocols and guidelines related to the practice of radiotherapy within subsite
Research and Innovation	<ol style="list-style-type: none"> 1. Partakes in independent research using advanced knowledge relating to H&N area of specialty 2. Collaborates with the multi-disciplinary team 3. Exploration and assessment of new techniques 4. Contributes to the development of new principles and concepts 5. Publication and presentation of research findings
Leadership	<ol style="list-style-type: none"> 1. Provides site specific expertise and leadership to RT team 2. Fosters teamwork and engagement of team members 3. Help drives department change and initiatives

Table 2
APRT Competency Framework.

APRT Competency Domain	Behavioral Descriptors
Expert Professional Practice <i>Improving the standards of radiation therapy care for patients</i>	Demonstrate excellent clinical skills and knowledge, ability to exercise sound judgment and professional autonomy in providing best standards of care for patients. Accepts responsibility and accountability for ones actions. Ability to provide innovative approaches to assessment and treatment, which are theory and evidence based, in order to achieve maximum outcomes for patients and the service/organization
Building working relationships <i>To communicate, establish and maintain working relationships and gain the co-operation of others</i>	Builds synergies at all levels through teamwork, trust and shared common goals between individuals, departments, divisions, institutions, business partners and all others concerned for the well-being of our customers (patients, staff and community). Relates to people in an open, friendly, accepting manner. Shows and fosters respect and appreciation for each person whatever that person's background. Initiates and develops relationships with others as a key priority
Leadership <i>Inspires individuals and teams to achieve high standards of performance and personal development</i>	*Providing direction & leadership - Provides clear direction and priorities. Clarifies roles and responsibilities and provide leadership. Understanding strategic context; Fosters the development of common vision. Demonstrate evidence of clinical governance and innovation *Coach & Develop Others -Accurately assesses strengths and development needs of employees. Gives timely, specific feedback and helpful coaching. Provides challenging assignments and opportunities for development *Establish Plans -Develops short- and long-range plans that are appropriately comprehensive, realistic and effective in meeting goals. Integrates planning effort across work units. *Develop Systems & Process - Identifies and implements effective processes and procedures for accomplishing work
Management <i>Organizes and delivers service objectives in a timely fashion</i>	Ability to organize and deliver timely service objectives through implementation of national priorities, resource utilization, standards of practice, risk management, performance management, project management, change management, strategic planning and working across boundaries
Education, training and development <i>Supports the education, training & development of others. Promotes a learning culture within the organization</i>	Providing effective supervision and mentorship at various systemic levels Demonstrate the characteristics of an effective role model Engage in educational planning, development and assessment within pedagogical framework Linking practice and education through contribution and formulation of higher educational qualifications

technical training and supervision, ensuring a smooth integration of these new roles. The APRTs enrolled in the program completed a series of concordance studies, matched against the assessment by ROs. A “pass score” of 90% concordance was set to denote a threshold for “competence”. APRTs were able to achieve a concordance of 90% or higher in 100% of the assessments. This led to the approval of delegated responsibilities and acts performed by competent APRTs.

Discussion

APRTs in Singapore have demonstrated that with appropriate education and training, they were able to perform to an acceptable standard on a variety of activities traditionally performed by a RO. From the patient perspective, the APRT positions have demonstrated increased access to care through greater efficiencies of specific tasks and processes along the treatment care pathway. There has been a redistribution of certain activities previously completed by RO, due to the attainment of advanced skills and increased responsibilities of the APRTs, which has led to decreased redundancy within patient care processes.

This section discusses the expanded roles and performance indicators achieved since the implementation of APRT roles in our Singapore. There are currently five APRTs in the following areas of clinical practice: H&N, Breast, Gynecological, Palliative and Lung. We will discuss some of our successes in the implementation and evaluation of some of these roles and their impact on patients and practice using clinical examples.

Role development and integration: Successes

APRT led treatment reviews

Radiotherapy treatment review (TR) is a widely accepted practice for patients undergoing radiation therapy [18]. The radiotherapy TR is usually undertaken on a weekly basis to assess the patient’s treatment related side effects as well as any other psycho-social issues relating to the treatment. In Singapore, this is usually performed by the patient’s primary RO or registrar. More recently with advancements in radiotherapy practice the pressure placed on an ROs time is much greater than in previous years through the implementation of advanced imaging, treatment technology and complex clinical practices. Due to the increased demand on RO’s time, it is necessary to implement new practices to allow ROs more time to concentrate on seeing more patients to ensure access to radiotherapy treatment is available to as many people as possible. TR Training was carried out for our H&N APRT.

Training program consisted of 6 months of observation of TR and one-to-one mentoring. The APRT attended TR to observe and record events according to disease, treatment previously provided and nature of incidence. During this period, APRT learnt correct documentation and assessment including the use of the Common Toxicity Criteria (CTCAE v 4). Concordance studies (Table 4) were conducted between APRT CTC assessment and RO assessment, and a pass score must be achieved before APRT is deemed competent to perform TR independently. A concurrent Review RT Clinics continued after the training period. This served as a bridging period between APRT training and full implementation of APRT led TR. This involved all patients reviewed twice - once by the APRT while at the same time still being reviewed as normal by the RO on their assigned review days. This period allowed for the APRT to gain further knowledge and experience in TR while still having

Table 3
Example of APRT Competency and Assessment Criteria Assessment: (Tick where applicable).

Expert Professional Practice				
Competency	Involves the ability to demonstrate excellent clinical skills and knowledge, ability to exercise sound judgment and professional autonomy in providing best standards of care for patients. Accepts responsibility and accountable for ones actions.			
Clinical skills, knowledge Including • Analytical skills • Judgmental skills • Interpretational skills	Unsatisfactory Only able to demonstrate general clinical skills and radiation therapy knowledge□	Competent Demonstrates Advanced radiation therapy skills and knowledge in core areas□	Good Demonstrates specialist clinical skills and radiation therapy knowledge in defined radiation therapy area(s)□	Exceeding Demonstrate excellent specialist clinical skills and radiation therapy knowledge.Develops specialist knowledge base in defined radiation therapy work area(s)□
Professional Autonomy	Limited ability to make independent decision and poor accountability in delivery of radiation therapy care to patients□	Practice autonomously within scope of practice to exercise some decision making while accepting professional accountability and responsibility□	Practice autonomously demonstrating expert problem solving and clinical decision-making skills while demonstrating professional accountability and responsibilityReviews professional policies and procedures in defined area(s) to bring about enhanced radiation therapy care□	Takes the professional lead for the organization within the context of the current professional and legal frameworks while remaining accountable for own practice.Shapes professional policies and procedures to advance overall radiation therapy practices, policies and strategies.□

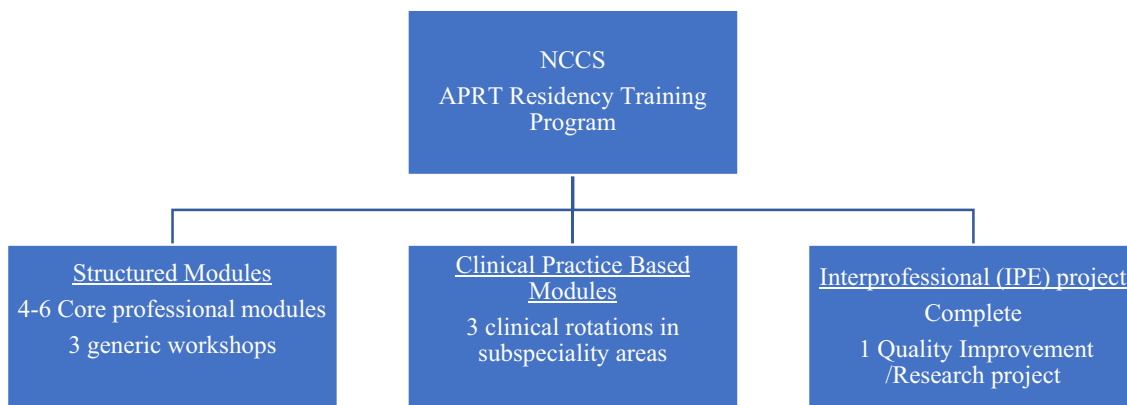


Fig. 2. APRT Residency Training Program.

Table 4
APRT concordance with ROs for H&N graded toxicities.

TOXICITY	Agreement (Kappa value)	% of concordance
Xerostomia	good (0.614)	78.1
Dysgeusia	good (0.608)	76.0
Pharyngeal pain	good (0.608)	74.0
Dermatitis	good (0.640)	76.0
Oral pain	moderate (0.594)	75.5
Mucositis	moderate (0.576)	71.1
Dysphagia	almost perfect (0.834)	88.5
Nasogastric tube insertion	perfect (1.000)	100

the safety-net of the patients still being seen weekly by their RO as well as by the APRT.

All clinicians and the majority of RTTs have expressed very positive views towards APRT led treatment review. These views have been gathered through both informal feedbacks sessions as well as through staff survey. Many treatment machine RTTs commented on the improved communication between the APRT and themselves as opposed to the RO or Registrar conducting TR. RTTs reported the process to be “extremely efficient” and neither clinicians nor RTTs experienced any problems or concerns with APRT led TR. Many RTTs also reported a high satisfaction level from patients. The APRT also expressed very positive feedback on their experience of APRT led TR. The APRT felt patients responded very positively to the experience and reported that patients often felt

they had more time to discuss the treatment processes and any concerns they were having with the APRT particularly because patients perceived the APRT to have more time to discuss any concerns regardless of how trivial the patients themselves felt their questions were at times.

Image approval

With the acquisition of advanced knowledge, skills and clinical judgement, APRTs can take on tasks once traditionally completed by ROs [19,20]. For example, our H&N APRT reviews day 1 and weekly image registrations in place of the ROs. The allocations of these tasks, led to improved efficiency on the treatment machines, less waiting time for patients and time savings for the ROs. The APRTs demonstrated concordance with the ROs in terms of image registration assessment and overall efficiency and timeliness in terms of image approvals. Through concordance studies, the APRT demonstrated a 99% agreement between the ROs and APRT in treatment field and tumor delineation and improved efficiency in terms of overall image approval.

Gynecology APRT led brachytherapy OAR contouring

The increase in demand for brachytherapy and the increasing use of High Dose Rate (HDR) in Singapore require strong leadership and oversight for effective planning and coordination of processes

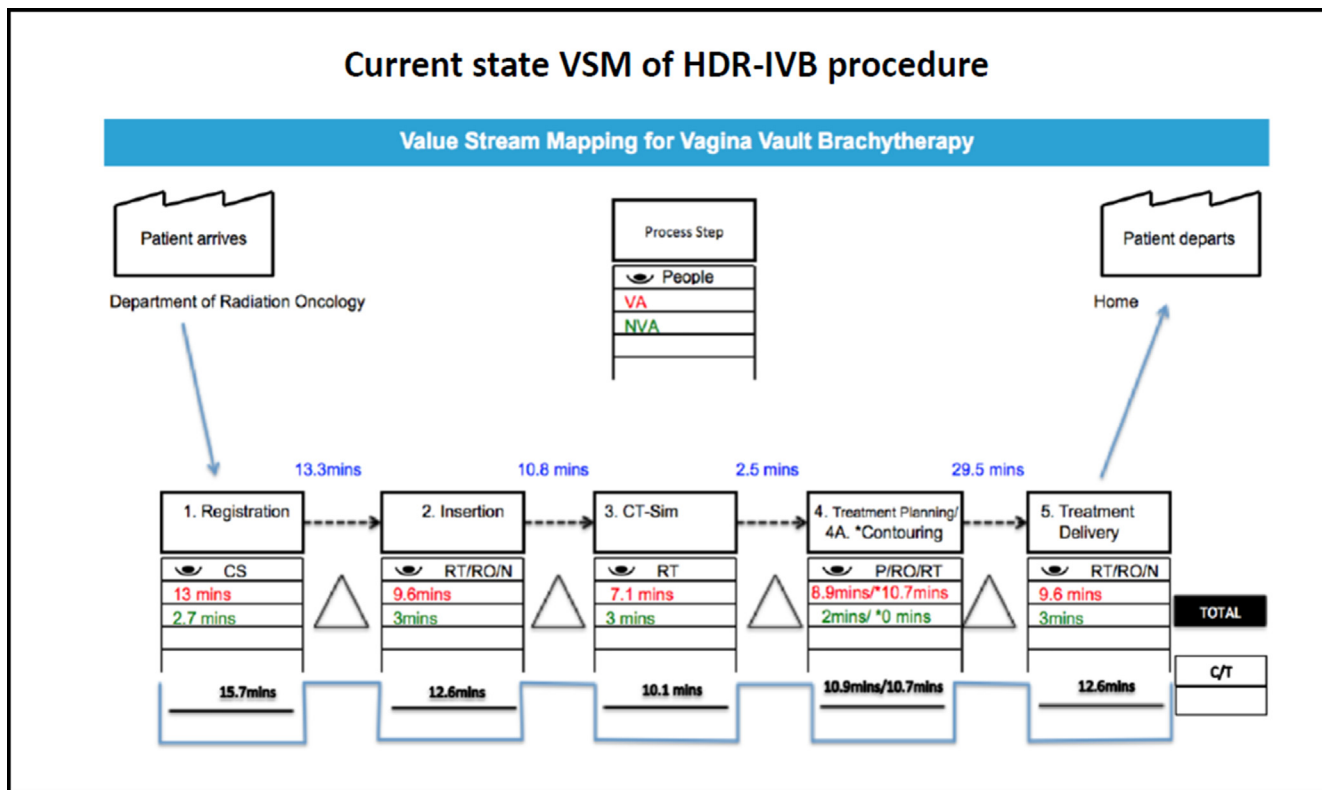


Fig. 3a. Current VSM of patient HDR-IVB procedure from patient arrival to completion of brachytherapy treatment).

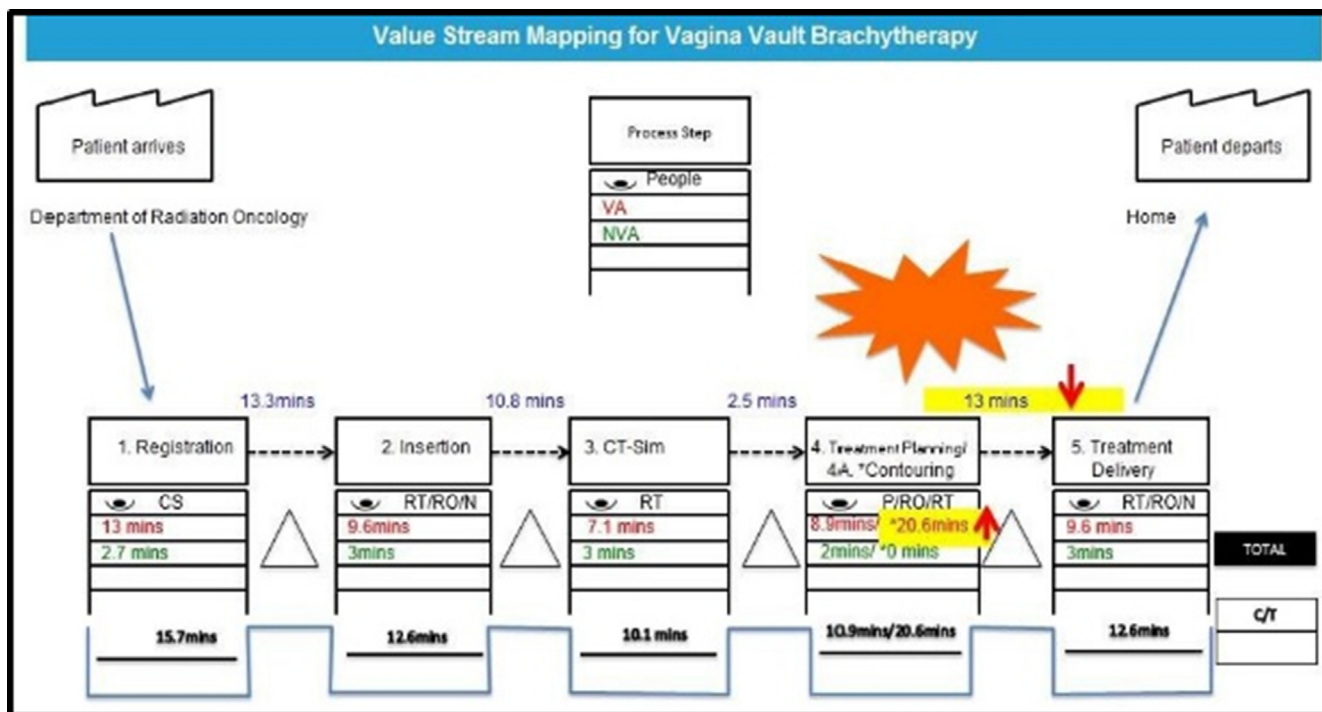


Fig. 3b. VSM of patient procedure with APRT role involvement.

to manage increased workload, maximize efficiency and ensure safe quality driven operations. An APRT Gynecological position was initiated in NCCS to enhance the effectiveness of the care that patient receive from pre -brachy care through to survivorship, min-

imize wait time and accelerate the development of new techniques and approaches.

A Value Stream mapping (VSM) was used to evaluate the value add of this new position. The attached VSM show the patient care pathways for intracavitary vaginal vault brachyther-

apy (HDR IVB). Each chart depicts the activities performed by the individual multi-disciplinary team members. The process was found to be inefficient especially the contouring process of OARs which was shown to cause the longest waiting timetable Fig. 3a. The addition of our gynecology APRT to take over the contouring role showed an effective lean initiative to reduce waiting time (Fig. 3b).

Integration of competency and assessment framework: successes

Streamlined coordination of care

The APRTs function as a key resource for cancer patients undergoing radiation therapy at the NCCS. First responders to patient's needs and being able to anticipate problems well ahead to circumvent complications later. Literature [21,22] has shown that Asians, especially Asian women have sexual concerns regarding their radiotherapy treatments but are too shy to bring up to ROs. APRTs serve as an important bridge and advocate to improve communications and allay patient's anxiety and fears. The APRT also helps to provide comprehensive, holistic care to cancer patients during their radiation therapy treatments by complementing and supplementing supportive care provided by the core team in accordance with the scope of practice and practice guidelines.

Triaging is an important task that APRT have included within their practice portfolio to positively impact improving access and care to patients. One of the key improvements was the management of seroma aspiration for post-mastectomy patients. Multidisciplinary collaboration between the breast APRT and the breast care nurses has established an efficient workflow with clear guidelines where patient from different hospitals with seroma issues would be advised and managed seamlessly ensuring proper patient care and unnecessary travels to patients. Seroma aspiration for patients are now seamlessly managed by APRT who will assess and evaluate these patients before each simulation procedures. The number of inappropriate patient consults decreased, and simulation scheduling became more efficient, decreasing patient wait times and delay in their start of radiation therapy treatments. The patients also benefited as they have a point person who can address their concerns in a timely manner and help them navigate the system.

Fast track simulation and treatment for palliative patients

Palliative radiotherapy is effective in reducing symptom burden and improving quality of life in patients with symptomatic metastatic cancer [23]. A palliative APRT role was developed in 2017 at the NCCS in collaboration with University of Toronto to provide training for this role. One of the aims of developing this position was to expedite and individualise the treatment and follow up for palliative patients requiring immediate radiotherapy.

The specific tasks of the palliative APRT's are to review patient's notes and diagnostic films before patients arrives in the department for treatment. Inpatient referrals received for RT are first assessed for urgency, by reviewing patient's history, current condition and recent diagnostic scans. If the referral falls under the urgent 'Sim & Treat' category, booking of the earliest simulation and treatment appointments are made. The APRT assesses the patient before the initial consultation with the RO. The initial patient assessment, history taking, and explanation of RT journey informs the patient about what to expect during the consultation with the RO, and contributes to the treatment management discussion between the APRT and RO.

The patient then proceeds with the start of their RT journey on the same day. The APRT is involved in each step – simulation, planning and treatment, for continuity of care by being the point of contact for the patient, RO and RTTs. Additionally, the APRT also assesses and advises on pain control during treatment, and ensures there is follow up care upon the completion of RT. Since the initiation of palliative APRT role, the total time taken from consultation to commencement of urgent palliative treatment for "Sim & Treat" patients have reduced from one day to only half a day – an important consideration for palliative patients with short life expectancy, and symptom alleviation that is time-sensitive."

Respiratory motion management for lung and liver patients

As radiotherapy equipment and techniques become increasingly advanced, the possibilities of delivering higher dose levels to increase local control, reduce side effects of treatment and thus giving patients better survival chances and quality of life become real[24]. Respiratory motion affecting most tumor sites in the thorax and abdomen is one of the biggest hindrances that prevents the safe delivery of high radiation doses to these regions.

Conventionally practiced in our department - passive approaches such as motion-encompassing techniques or forced shallow breathing were used to manage respiratory motions during RT treatments. However, these techniques still require large treatment margins and are thus inadequate when delivering highly conformal radiotherapy treatments such as hypo fractionated stereotactic ablative body radiotherapy. As such, it became more apparent that the expertise and experience of a specialized RTT will be very relevant to facilitate in the management of respiratory motion for lung and liver cancer patients who require RT. Thus, the lung APRT position was created.

Our lung APRT is currently still undergoing her training program. However, during this period, she has helped develop the workflow and work instructions for breath-hold procedures in the department. The lung APRT conducts initial patient assessment for suitability to undergo BH procedures. She conducts BH coaching to patients and follow through with the patient's simulations and treatments. This has, up to date, enabled 13 patients who require lung or liver RT to be successfully treated with breath-hold as an active respiratory management technique.

APRT residency training program – needs and benefits

A need to develop a structured training program has been discussed in many literatures[4,11,15]. A structured formalized 1-year APRT residency training program was developed to address this need. The expertise and experience required of an APRT cannot be attained with "casual" on the job training. A formal structured residency program is necessary to ensure that aspiring APRTs are adequately trained and equipped with the skills for advanced practice.

There is currently no other similar formal structured APRT residency training offered in Singapore or Asia. Upon completion of this program, Residency graduates will be able to practice independently and will serve as a valuable resource for information, educating fellow healthcare professionals on complex clinical practice. Building upon the research and education skills, they have acquired during their residency, graduates will be able to conduct APRT led education and research works. These individuals will be capable of conducting their practice with a high level of professional autonomy, maturity and leadership.

Examples of APRT led education and research works

Academic and research activity through knowledge creation and dissemination is an important aspect of our APRT roles. As they develop advanced knowledge, skills and judgement in their area of specializations, the APRTs naturally begin to take the lead and direct initiatives related to new treatment approaches and education. All APRTs are regularly engaged in scholarly work such as development of training programs, conducting workshops and training as well as patient centered research for example the use of “invisible” tattoos and patients’ sexual information needs assessments.

Protocols such as CT work processes, patient’s workflow, motion management strategy, imaging protocols were also continuously developed by APRTs to ensure clear guidelines and safe and accurate treatments.

Future works

For new roles to be implemented successfully, there must be multi-disciplinary support, especially from the medical practitioners. Role development is often accompanied by sensitivities and anxiety, especially when the role was previously performed by a medical practitioner [25,26]. Medico legal and ethical issues need to be explored [22] and there should be mutual benefits and agreement between ROs and RTTs if such a role change is to be implemented. Most importantly, there must also be improvement in cancer services and maximum benefit to the patients. This would help maintain skills across all hospitals so staff could move around and share experiences. Collaborations with the workforce policy and planning unit is important to ensure barriers such as legislation restrictions, insurance requirements and costs associated with the education, implementation and maintenance of advanced practice roles are considered. The rapidly changing nature of the profession both in its education requirements and evolution of technologists means the scope of practice for this profession requires constant review.

Future work includes characterizing the knowledge gap in under-served regions and describe the competencies that APRTs could offer to bolster the existing team’s capabilities and improve patient’s access to quality radiation treatment. The APRT should play a key role in engaging patients, providing support and counseling from the onset of treatment through survivorship. This will serve as a vehicle for post treatment care and outcomes assessment. Last but not least, the issues of legal, regulatory and registration of advanced practitioners need to be initiated. In the UK, the Society and College of Radiographers[27] has now recognized that in order to support advanced practitioners, assure the public of high quality service and maintain consistency in the use of the “Advanced Practice Practitioner” title, some form of registration or regulations must exist. In Singapore, much work needs to be done in this area. National collaboration is needed to form a unified structure for the implementation of APRT in Singapore.

Conclusions

In summary, our APRT implementation program in Singapore employed an evidence-based implementation process that tested the feasibility of a new practice model, defined a possible scope of practice and measured the impact of the role in a systematic manner. Through our program, our APRTs have demonstrated that they were able to perform to an acceptable standard on a variety of activities traditionally performed by a RO. We have successfully implemented 5 APRT positions in NCCS and 3 other positions are currently being planned for implementation across another cancer

center in Singapore. Important to note that multidisciplinary involvement in the design and implementation of APRT residency program, mentorship and clinical training were important factors for the success of any APRT implementation program.

Declaration of Competing Interest

The authors of this article report no conflict of interest.

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