IMPROVING QUALITY AND SAFETY IN RADIOTHERAPY USING WEB-BASED LEARNING

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Abstract– **To meet the need for training in techniques of quality and safety improvement in radiotherapy an e-learning program has been developed. Topics such as Incident Learning, Failure Modes and Effects Analysis and Safety Culture are introduced and discussed. The program consists of approximately 1200 slides with voice-overs, divided into 12 modules, and can be completed typically in 5-7 hours of self-study. A survey of early registrants strongly suggests that the program has been very well received and has been found to be useful and easy to access.**

Key Words– **quality, safety, radiotherapy, e-learning.**

I. INTRODUCTION

Concurrently with rapidly developing technology there has been an increasing emphasis on safety and quality in radiotherapy in recent years. While radiotherapy professionals have always placed the patient at the centre of their practice, reports in the popular press and scientific literature have highlighted those rare but devastating events which have seriously compromised clinical outcomes and even led to the deaths of patients.

Reflections of the high-level interest in and commitment to improving the quality and safety of radiotherapy are the publication of a number of reports, by professional and scientific bodies, discussing the current situation and making recommendations for improvement. Altogether these reports run to many hundreds of pages, contain a large number of recommendations, and inevitably have some overlap. However, one consistent theme runs through many of these influential documents. An analysis of 7 such publications has identified education and training as a recommendation for safer radiotherapy in all 7[1]. Although the focus of such education and training is rarely specified and is presumably aimed at developing competence in routine clinical activities, given the current emphasis on quality and safety it seems reasonable to add these topics to any program for radiotherapy professionals already in the field or in training.

There are, however, major challenges in developing effective programs. The provision of radiotherapy care is very much a multidisciplinary team effort with radiation oncologists, medical physicists and radiation therapists as the primary, but by no means the only, players. An ideal educational program would be relevant and useful for these different disciplines. However, an even bigger challenge is making such a program practically accessible to all in the radiotherapy field irrespective of the funding context of their situation. The enormity of this particular challenge can be gauged by looking at the number of medical physicists worldwide. One estimate has put this number at 24,000[2]. If European ratios[3] between the different professional groups are applicable worldwide then, based on the estimate for the number of medical physicists[2], there are over 100,000 radiotherapy professionals who could potentially benefit from education in quality and safety. Traditional approaches to learning cannot even start to address a challenge of this enormity and other options have to be explored.

The internet is establishing itself as probably the premier vehicle for the dissemination of educational material to very large audiences. Certainly, in medical physics there are many programs available bringing significant benefits to the community through the ease of accessibility[4].

The International Atomic Energy Agency (IAEA) has chosen the web as the basis for its program on Safety and Quality in Radiotherapy. The project, described in this brief article, was funded through the IAEA's Technical Cooperation Program in the Asia Pacific Region.

II. MATERIALS AND METHODS

A. The Educational Program

The overall aim of the program was described thus: *This e-Learning Program is designed to equip radiotherapy professionals with the knowledge to enhance the safety and quality of their practice and hence to provide patients with optimum outcomes.*

Good pedagogical practice was used to drive the design of the program. The content was divided into 12 modules with each module further divided into 3 – 5 sections. As far as possible these sections were self-contained and were largely understandable without reference to other sections. This structure allowed busy professionals to fit their learning activities in between clinical obligations without the necessity to refresh memories on previously studied sections. Each module and section starts with a list of objectives so the learner knew exactly where they were going. Likewise each section concludes with a brief summary reminding the learner of where they have been.

Common strands running through a program such as this can be helpful to the learner in providing continuity as well as reinforcing messages. The themes running through much of this program were three well-known radiotherapy accidents. These will be identified later.

At the end of each module is a 6 question quiz which can be repeated as often as desired. Such quizzes have value both for the learner and the learner's institution. The learners confirm for themselves that they have an adequate grasp of the material presented. Successful completion of all 12 quizzes results in the award of Certificate of Completion. From the institution's perspective the Certificate of Completion verifies that an individual has satisfactorily

completed the course. This feature could be particularly valuable for undergraduate, graduate and residency education and training programs which incorporate Quality and Safety in their curriculum.

Articulate web-based learning software (https://articulate.com) was used for course development. Volunteers from within the IAEA provided voice-overs, from a script, for each element of the program.

The program was implemented on the Cyber Learning Platform for Network Education and Training (http://clp4net.iaea.org). This platform allows users to easily find education resources and supports the dissemination of e-learning self-study resources to a wide audience.

B. Users' Evaluation

To ensure the program was achieving its objective and that there were no unforeseen problems with any of the content, format or navigation tools an on-line survey of users who signed up within the first four months after release was conducted. The first 4 questions elicited demographic data about the responder. The next 16 questions, with responses on a 5 point Likert scale, enquired into issues such as the utility of the program and ease of access. The final 5 questions were free text and allowed the responder to make comments and suggestions in an unstructured way.

III. RESULTS

A. The Educational Program

The educational program was released on the IAEA website on 1st December 2016 (http://elearning.iaea.org/m2/course/view.php?id=392). To access the program the user has to first register with NUCLEUS which is straightforward and free. As mentioned previously the program itself consists of approximately 1200 slides with voice-overs, divided into 12 modules, which in turn are divided into 3-5 sections, Figure 1.

On entering the program the first slides encountered present an outline of the content and describe the convenient navigation tools which are built in.

A very brief synopsis of the content of each of the 12 modules is provided below.

Module 1 sets the scene by looking at the scope of the cancer problem worldwide; suggests the connection between quality and safety in radiotherapy; looks at the limited statistics on incidents in radiotherapy and concludes with an overview of some of the recent literature and recommendations in the field.

Fig 1. An example of an entry screen into a module.

Module 2 introduces the three threads that run though much of the program. The well-known radiotherapy incidents in New York State, U.S., Epinal, France and Toulouse, France are described with the descriptions based on the excellent summaries developed by the IAEA(https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/1_TrainingMaterial/AccidentPreventionRadiotherapy.htm).

Module 3 introduces the learner to Incident Learning Systems with a discussion of the structural and design features of such systems, an overview of some of the currently available systems and concludes with a detailed discussion of the IAEA's Safety in Radiation Oncology (SAFRON) system (https://rpop.iaea.org/RPOP/RPoP/Modules/login/safron-register.htm).

Module 4 delves deeper into the key components of an Incident Learning System. The 4 sections in this module address Process Maps, Severity Metrics, Basic (or Root) Causes and Safety Barriers.

Module 5 sees a return to the SAFRON approach (from Module 3) to incident learning in which the 3 incidents described in some detail in Module 2 are entered into SAFRON. It will be apparent from this module that even reporting incidents, which is an essential feature of an effective safety culture, is far from straightforward as we rarely know precisely what happened.

Module 6 commences the examination of the engine of an Incident Learning System, viz. Root Cause Analysis (RCA). Following an overview of the principles of RCA there are brief discussions of Rasmussen's human factors model and Basic Causes. The module demonstrates the challenges of identifying Basic Causes through examination of the 3 theme incidents: New York State, Epinal and Toulouse.

Module 7 delves deeper into an effective Incident Learning System through discussions of Safety Barriers and Preventive Actions. Again the discussion is facilitated through the use of the 3 theme incidents in the context of the SAFRON Incident Learning System.

Module 8 moves from retrospective safety and quality management accomplished through the use of Incident Learning Systems to the complementary approach of

prospective techniques and, in particular, Failure Modes and Effects Analysis (FMEA). Following an everyday example of the application of FMEA, subsequent sections of the module present suggestions as to how an FMEA might be applied to the clinical situations in which the 3 theme incidents occurred.

Module 9 introduces the prospective quality management tool of Fault Tree Analysis and again the 3 theme clinical situations are used to illustrate the application of the technique.

Module 10 moves to the overarching issue of Safety Culture. The discussion is based on the 10 safety traits identified by the IAEA[5]. Each of these 10 safety traits is disaggregated into their component parts and suggestions are made as to the measures that might be implemented in practice to enhance concordance with the traits, Fig. 2.

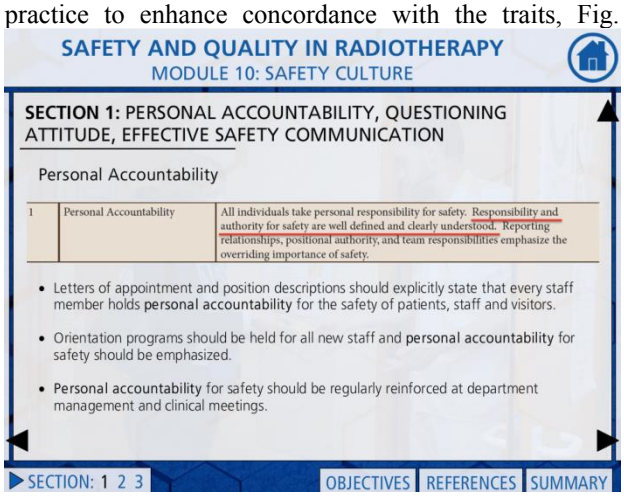

Fig. 2. An example of the advice provided to enhance concordance with one statement in the first safety trait.

Module 11 identifies additional resources to help the individual practitioner and clinic maintain and enhance the safety and quality of care delivered to radiotherapy patients. The resources discussed include the IAEA sponsored Quality Assurance Team for Radiation Oncology[6] and the AAPM's Safety Profile Assessment[7].

Module 12 addresses some very practical issues surrounding the application of the knowledge and tools presented in this e-learning program. The establishment of an effective and efficient Quality Assurance Committee is one such issue. A possible budget, in terms or personnel time, is also presented so that individuals and clinics are fully cognisant of the resources they need to commit if they are serious about moving their quality/safety agenda forward.

Each of these modules is followed by a quiz consisting of 6 multiple choice questions. The pass mark is 5/6 correct answers. However, the quizzes may be taken multiple times. Success at all 12 quizzes leads to the award of a Certificate of Completion.

This program was released on 1st December 2016. At the time of writing, October 2017, 1281 individuals have registered and 337 have been awarded a Certificate of Completion.

B. Users' Evaluation

At the time of the survey 120 registrants had been awarded Certificates of Completion and were invited to participate in the users' evaluation. Of these, 48 from 32 different countries responded.

By far the majority of those who responded were medical physicists, Fig 3.

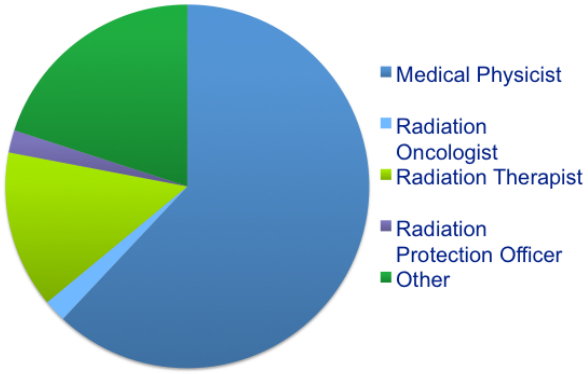

Fig 3. The distribution of professions amongst responders.

There was very strong agreement amongst the responders that the program was easy to access, Fig 4.

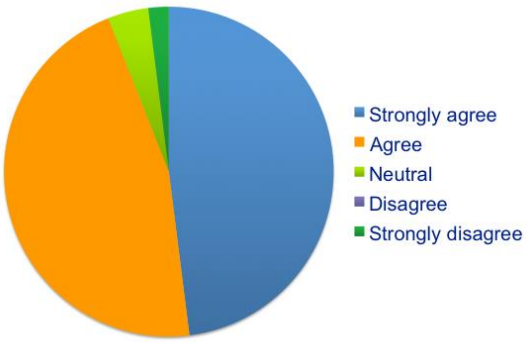

Fig 4. The survey statement was: It was easy to access the e-learning.

Responders were asked about their views on the overall presentation of the on-line course, Fig 5.

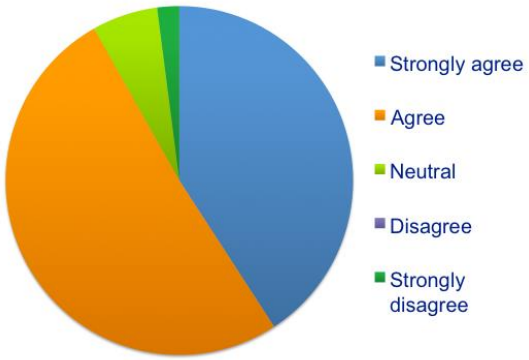

Fig 5. The survey statement was: The design of the course was appealing and easy to follow.

The course content was considered to be relevant to the needs of the majority of responders, Fig 6.

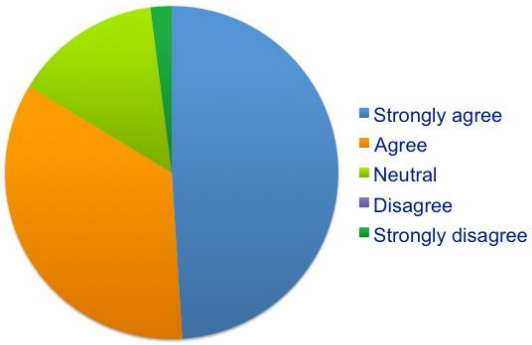

Fig 6. The survey statement was: The content of the course provided was relevant to my needs.

Clearly it is important that any course should meet its goals and, from the responses received, this course did, Fig 7.

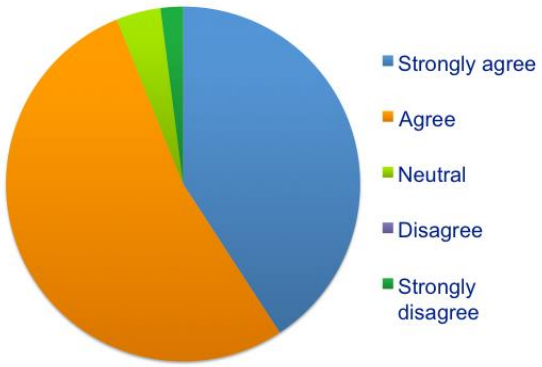

Fig 7. The survey statement was: The course met the goals and objectives.

Amongst other information gleaned from the survey was that more than 70% of responders were between the ages of 25 and 35; 40% had between 1 and 5 years clinical experience while 25% had more than 15 years.

In the majority of cases (40%) the course took 5 – 7 hours to complete.

Minor, but rare, constructive criticisms received were that some of the graphs were overly complex and, on occasion, the narration was too fast.

IV. Discussion

Overall, this e-learning project has reached its aim as defined earlier in this paper. The responses from the survey, although limited, have been very positive. At the outset of the project its uptake was unknown. With very limited promotion current registration is running at ???? which is certainly satisfactory after less than one year since release. However, the data in Figure 3 do serve to highlight a not unexpected challenge. Uptake by professions other than medical physics is quite low. Educational programs of all types on Quality and Safety in radiotherapy, and the experts to deliver them, are in relatively short supply. This particular e-learning program has the potential to fill a much needed, but perhaps unrecognized demand, particularly at the trainee level.

V. Conclusion

A 12 module e-learning program on Quality and Safety in radiotherapy has been developed. The program of approximately 1200 slides with voice-overs takes typically 5 – 7 hours to complete and, with success at 12 quizzes, leads to the award of a Certificate of Completion. The program has been well received by the initial cohort of registrants.

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