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Professional paper

# Practices of Radiotherapy Equipment Quality Control in Radiotherapy Centres in Croatia

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**A B S T R A C T**

*From the prescription to the delivery of a radiotherapy treatment, a team of professionals from a number of disciplines is involved. In this way significant potential for errors leading to an accidental exposure becomes apparent. Comprehensive quality assurance/quality control (QA/QC) program to minimize such errors is, therefore, required. One aspect of QA/QC program is quality control of the equipment. In this paper we present experiences in establishing QC procedures in our centers. Also differences in QC practices in Croatian radiotherapy centers are reviewed in the light of recommendations given by international reports and publications. To obtain insight into the current employed protocols a questionnaire based on our QC protocols was made and it was sent to all radiotherapy institutions in Croatia. QC procedures and tools used, professionals involved, performance frequencies of the tests and tolerance/action levels are compared. All centers perform the great majority of QC tests, but some variations in the performance frequencies of QC tests and in personnel responsible for performing particular tests are found. Reviewing of QC practices and exchanging experience could help in evolving uniform protocol for QC procedures at national level.*

***Key words:*** *radiotherapy, quality assurance, quality control, Croatia*

## Introduction

From the prescription to the delivery of radiotherapy treatment, a team of professionals from a number of disciplines is involved in a large number of steps. In this way the significant potential for mistakes leading to an accidental exposure becomes apparent and comprehensive quality assurance/quality control (QA/QC) program is, therefore, required. One of the most important aspects of QA/QC program is quality control of the equipment used for the treatment planning and therapy. In this paper we present experiences in establishing QC procedures in radiotherapy in our centers. Also differences in QC practices in Croatian radiotherapy centers are reviewed in the light of recommendations given by international reports and publications[1–6].

## Materials and Methods

At our institutions first QC protocols were made more than ten years ago, when first linear accelerators were installed. During that period the protocols were developed and expanded to all radiotherapy equipment (simulators, cobalt units, brachytherapy units) according to international recommendations. The main criterions, depending of parameter of interest, for the QC evaluation were: functionality, reproducibility and precision. According to this written protocols were made for daily, weekly, monthly, quarterly and yearly procedures. It comprises description of procedures, equipment used, tolerance/action level and the staff member responsible for the execution of the procedure.

To obtain insight into the current employed protocols a questionnaire based on our QC protocols was made and it was sent to all radiotherapy institutions in Croatia. It concerned different parameters of QC (security, mechanical, and dosimetrical), protocols, methods, frequencies, equipment used and time required for the test, as well as tolerance/action levels and personnel responsible for performing QC tests. All centers responded and results of the questionnaire for 17 radiotherapy machines (3 cobalt units, 6 simulators, 8 linear accelerators) were analyzed

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to provide an overview of the current QC practice of radiotherapy equipment.

## Results

The presence of written protocols is a mile stone of QA/QC procedure. We found that less than 50% centers developed their own protocols according to international recommendations (Figure 1).

This is very important issue because the lack of written protocols may result in different interpretation of acquired data by different users, the frequencies of tests are often arbitrary and the evaluation of the tolerance/action levels are usually left to the member of the staff involved in performing the check. A much better uniformity between centers is present regarding the protocols for the calibration of dose monitor system on weekly basis. All institutions with linear accelerators have made written protocols for this aspect of QC procedures and it is most often based on IAEA Code of Practice[7]. This part of QC procedure is also regulated by the law and it is mandatory.

Since there were a number of analyzed parameters in the questionnaire, for the purpose of this work we abstracted only part of them. Therefore we will briefly comment founded discrepancies in frequencies of particular procedure, time spent for the radiotherapy equipment QC procedure, personnel involved in performing the procedure, equipment used for the mechanical/optical checks, and tolerance/action levels. The others would be discussed elsewhere.

We found large variety in test frequencies for the same parameter, e.g. in some institutions laser alignment check is performed on daily basis while other performs it on weekly or even monthly basis. One of the reasons for this is different workload of radiotherapy departments and technically it is seldom possible to integrate QC procedure in working hours of the department, since in most institutions radiotherapy machines are engaged with the patients from early in the morning until late in the evening.

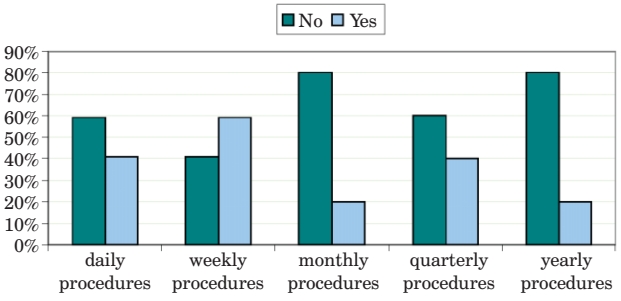


*Fig. 1. Existence of written protocols in radiotherapy centers in Croatia.*

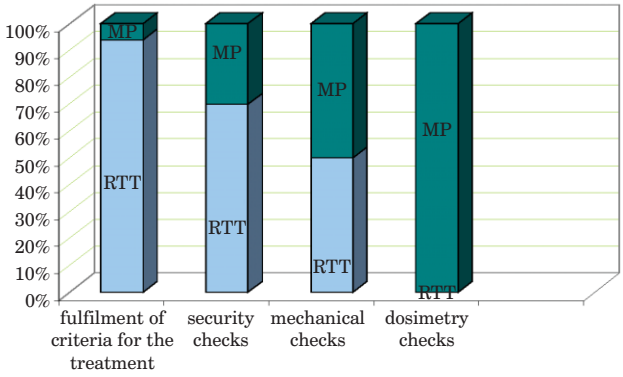


*Fig. 2. Personnel involved in performing QC checks. MP – medical physicist, RTT – radiation therapist.*

Reported time spent for performing e.g. monthly procedures varied from 1 hour to 3 hours per machine. The main reason for this difference is a lack of uniformity in defining QC procedures (protocols) between centers.

Variation in staff involved in performing different kind of checks is also noted. Compliance is present only in weekly dosimetry checks which are performed by the physicists. Typically, all the checks must be performed under the physicist's supervision, whether in some institutions physicists performed majority of tests themselves, in other the majority of tests are performed by radiation therapists. This is illustrated in Figure 2.

There is only one center that use specially designed QC tools recommended for the mechanical/optical checks. All others use improvised devices which might result in different interpretation of acquired data by different users. Main reason for the use of improvised arbitrary appliances is low awareness by decision makers regarding importance of QC procedures for the clinical use of radiotherapy machines.

Discrepancies found between tolerance/action levels amongst the institutions were negligible. Nevertheless, some ambiguity regarding tolerance levels are present (Table 1) One of the reasons for deviations could be found in different literature used.

**TABLE 1**
TOLERANCE LEVEL DISCREPANCIES

| | | Tolerance level | |
|---|---|---|---|
| Collimator angle indicator | (1–2)° | 1° | 2° |
| Optical distance indicator | < 1 mm | < 2 mm | (1–2) mm |
| Radiation isocenter – gantry rotation | (1–2) mm | < 1.5 mm | < 2 mm |
| Output calibration – photon energy | (1–3)% | < 3% | (1–2)% |

## Discussion and Conclusion

The results of the questionnaire show that, despite the fact that up to this day it is not regulated as a mandatory by the law, radiotherapy equipment QC procedures take place in Croatian radiotherapy departments on regular basis. Nevertheless, the lack of legislative in this field results in problems with incorporation of QC procedures in busy radiotherapy departments. In this way regular implementation of the procedures are usually left to conscience of the medical physicists.

The lack of written protocols for QC procedures is also noted. According to this, large variations in test frequencies, time spent for performing different procedures, staff involved and tools used for the procedures are present. Pointing out these problems we would like to contribute formulating a uniform set of minimum requirements for the QC of radiation therapy equipment, according to international recommendations. We found this as a very important issue, especially at this time when radiation therapy equipment became very sophisticate. Furthermore, need for formulating a minimal requirements as well as its implementation should be extended to 3D treatment planning systems, brachytherapy equipment and mold room equipment, leading to the implementation of QA/QC system in every part of radiation therapy procedure.

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