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RISK MATRIX ANALYSIS ACTIVITIES IN SPAIN

EAN meeting - Paris

Nov 30th - 2016

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1 INTRODUCTION

IAEA International Atomic Energy Agency

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Application of the Risk Matrix Method to Radiotherapy

IAEA TECDOC No. 1685

Subject Classification: 0103-Medical physics (including dosimetry)

English IAEA-TECDOC-1685; (ISBN:978-92-0-107216-0); 74 pp.; 13 figures; € 18.00; Date Published: 2016

This book is also available in:

Spanish

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Description | Keywords | © Rights and permissions

This publication describes a project to introduce a tool for self-evaluation by radiotherapy services that allows the analysis of errors or failures that might give rise to accidents. The results of applying this tool to a generic radiotherapy service are also presented. These results are used as a basis for a set of recommendations to strengthen quality and safety programmes in radiotherapy departments. Both operational experience (lessons learned from accidental exposure) and the results of probability safety assessment studies have been taken into account in applying the tool and formulating these recommendations.

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2 RISK MATRIX - SEVRRA

- **Patient safety** is related to the risk derived from failures and mistakes in the therapeutic proccess

***Report: "Radiotherapy Risk Profile"* (WHO 2008)**

Injuries	**1723 patients**	**33 muertes (0,02%)**
No harm	**4349 incidents**	

Must be part of Quality Management program

2 RISK MATRIX - SEVRRA

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Análisis Probabilista de Seguridad de Tratamientos de Radioterapia con Acelerador Lineal

IAEA TECDOC No. 1670

Subject Classification: 0612-Safety analysis

Spanish IAEA-TECDOC-1670/S; (ISBN:978-92-0-322610-3); € 18.00; Date Published: 2012

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2 RISK MATRIX - SEVRRA

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Spanish IAEA-TECDOC-1670/S; (ISBN:978-92-0-322610-3); € 18.00; Date Published: 2012

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Description | Rights and permissions

This publication addresses the issue of accidental exposures of radiotherapy patients and how to avoid them. More proactive approaches are required to anticipate and thus avoid situations that could lead to accidental exposures. In this context, the International Atomic Energy Agency (IAEA) and the Ibero American Forum of Radiation and Nuclear and Safety Regulatory Agencies (the FORO) have applied proactive methods, such as probabilistic safety assessment to radiotherapy treatments with accelerators. The methodology and results of this exercise are described in this publication.

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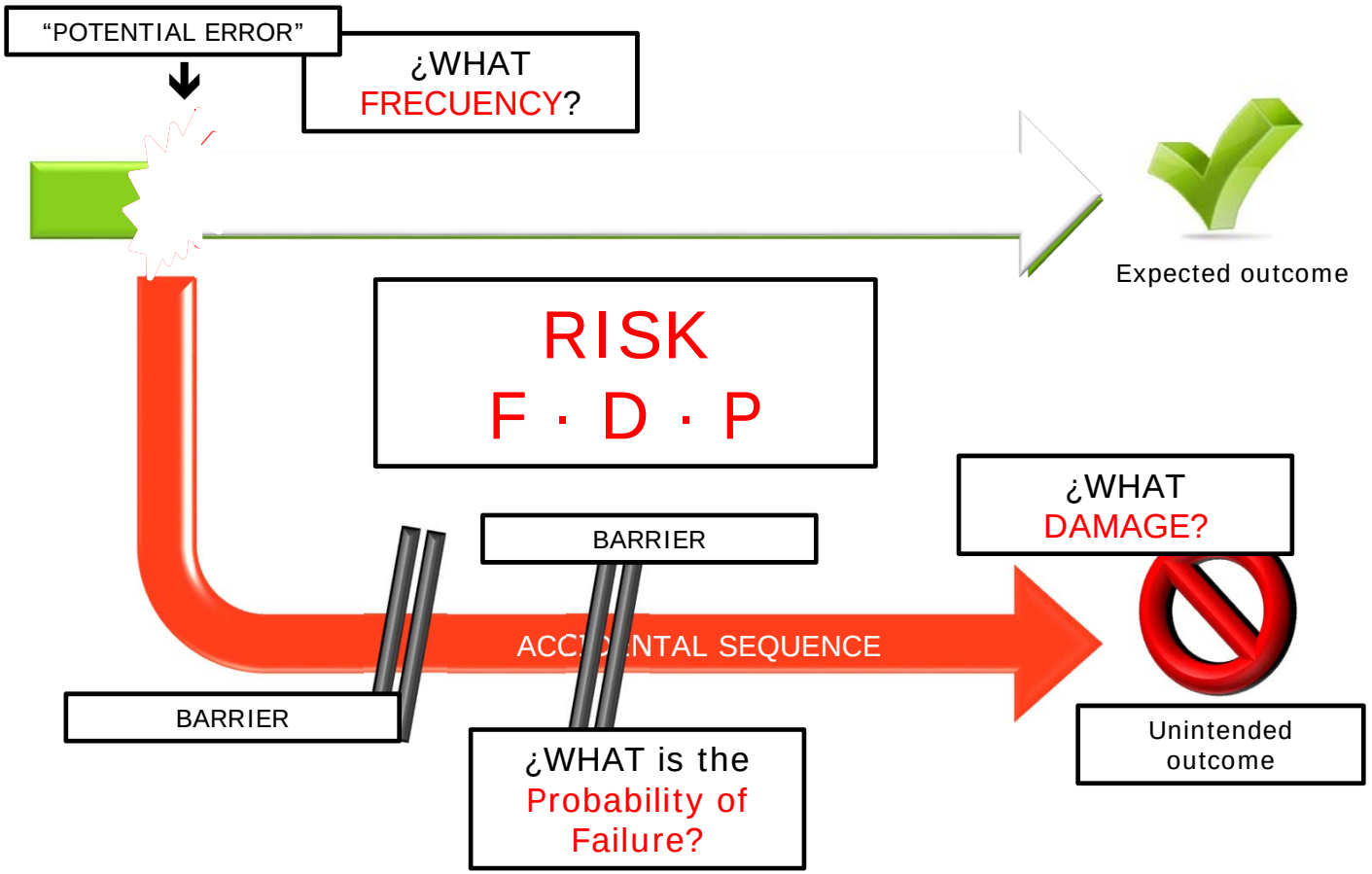
RISK MATRIX ANALYSIS IN SPAIN



Risk Matrix Methodology

Initiating event were identified and its potential harm were analyzed also the safety barriers existing in the radiotherapy department to avoid it were recorded. The frequency of occurrence of the initiating events were computed according with the following criteria.

Annual frequency (for 500 patients/year)	Frequency level	Acronym	Qualitative
More than 50/year	High	FH	The event occurs frequently
Between 1 and 50 /year	Medium	FM	The event occurs occasionally
Between 1/year and 1 every 100/years	Low	FL	It is unusual or rare, although it is assumed that it has ocurred
Less than 1every 100/years	Very low	FVL	It is very unusual, and it is not known to have occurred but there is a remote possibility

Risk Matrix Methodology

Safety measures or barriers in place to avoid, prevent, detect and stop an accidental exposure or to mitigate its consequences were identified. Safety measures may be of a technological (such as interlocks) or organizational nature (such as procedures or double checks to avoid or detect an error.) Their probability of failure were determined, in a first step, according with the following criteria.

Probability level	Acronym	Number of barriers
High	PH	There is no barrier at all
Medium	PM	There are one or two barriers
Low	PL	Three barriers
Very Low	PVL	Four or more barriers

Risk Matrix Methodology

The scale of consequences should take account of the severity and the number of patients affected. It ranges from the death of the irradiated patient to a simple loss of defense in depth with no health effect. The table shows the scale for the consequences used for patients, adapted from the definitions in ICRP 86 (ICRP 2002).

Severity level	Acronym	Description
Very high, catastrophic.	CVH	Causing multiple deaths or limiting damage to multiple patients (roughly more than 25% under or overdosage can cause this effect).
High	CH	Causing single death or limiting damage to multiple patients. Also deviation of 10 and 25% to multiple patients are included in this level
Medium or moderate	CM	No risk to patient life, only recoverable deviation affecting one or a few sessions
Low	CL	Reduction of defense in depth with no dose deviation.

2 RISK MATRIX - SEVRRA

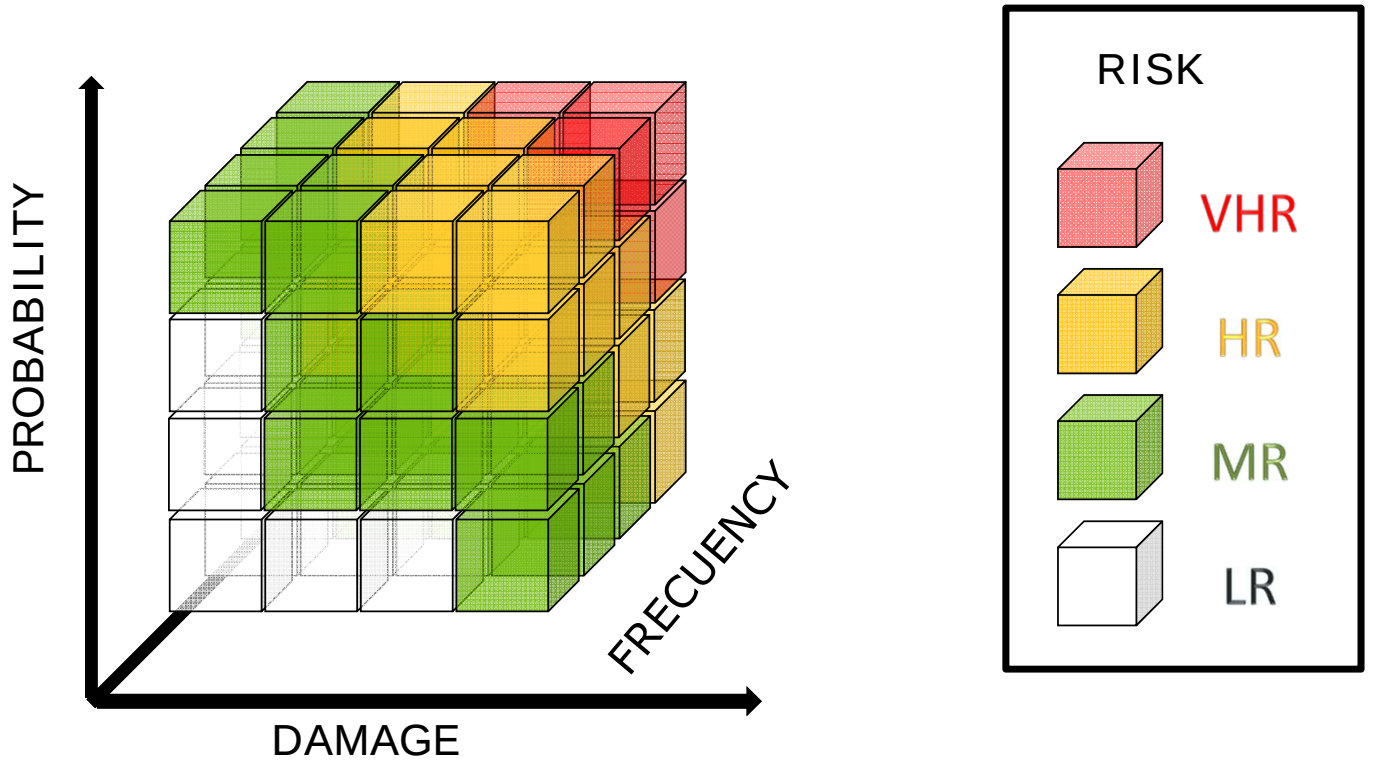
PH	CVH	CH	CM	CL
FH	RVH	RVH	RH	RM
FM	RVH	RH	RH	RM
FL	RH	RH	RM	RM
FVL	RH	RH	RM	RM

PL	CVH	CH	CM	CL
FH	RH	RH	RM	RL
FM	RH	RH	RM	RL
FL	RM	RM	RM	RL
FVL	RM	RM	RM	RL

PM	CVH	CH	CM	CL
FH	RVH	RH	RH	RM
FM	RH	RH	RM	RM
FL	RH	RH	RM	RL
FVL	RH	RM	RM	RL

PVL	CVH	CH	CM	CL
FH	RH	RM	RM	RL
FM	RM	RM	RM	RL
FL	RM	RL	RL	RL
FVL	RM	RL	RL	RL

2 RISK MATRIX - SEVRRA



2 RISK MATRIX - SEVRRA

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Aplicación del Método de la Matriz de Riesgo a la Radioterapia

Texto Principal

IAEA TECDOC No. 1685

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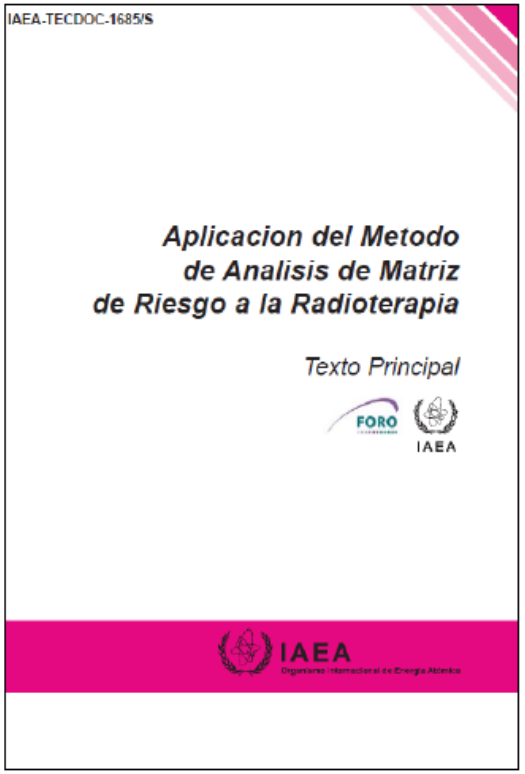
2 RISK MATRIX - SEVRRA

ORIGINAL RISK MATRIX - RESULTS

INITIATING EVENTS	**141**	
Consequences on the patients	132	93.6 %
Consequences on the workers	5	3.5 %
Consequences on the public	4	2.8 %
Human Error related	111	78%
BARRIERS	**100**	
Risk Reducers	37	
Consequence reducers	26	
Very high risk sequences	0	0
High risk sequences	5	4%
Medium risk sequences	126	89%
Low risk sequences	10	7%



2 RISK MATRIX - SEVRRA

Paper

PREVENTION OF ACCIDENTAL EXPOSURE IN RADIOTHERAPY: THE RISK MATRIX APPROACH

J.I. Vilaragut,* C. Duménigo,* J.M. Delgado,† J. Morales,‡ J.D. McDonnell,§ R. Ferro,* P. Ortiz López,** M.L. Ramírez,†† A. Pérez Mulas,‡‡ S. Papadopulos,‡‡ M. Gonçalves,§§ R. López Moreues,*** C. Sánchez Cayuela,† A. Cascajo Castresana,‡‡ F. Somoano,††† C. Álvarez,‡‡ A. Guillén,* M. Rodríguez,‡‡ P.P. Pereira,‡‡‡ and A. Nader**

Abstract—Knowledge and lessons from past accidental exposures in radiotherapy are very helpful in finding safety provisions to prevent recurrence. Disseminating lessons is necessary but not sufficient. There may be additional latent risks for other accidental exposures, which have not been reported or have not occurred, but are possible and may occur in the future if not identified, analyzed, and prevented by safety provisions. Proactive methods are available for anticipating and quantifying risk from potential event sequences. In this work, proactive methods, successfully used in industry, have been adapted and used in radiotherapy. Risk matrix is a tool that can be used in individual hospitals to classify event sequences in levels of risk. As with any anticipative method, the risk matrix involves a systematic search for potential risks: that is, any situation that can cause an accidental exposure. The method contributes new insights: The application of the risk matrix approach has identified that another group of less catastrophic but still severe single-patient events may have a higher probability, resulting in higher risk. The use of the risk matrix approach for safety assessment in individual hospitals would provide an opportunity for self-evaluation and managing the safety measures that are most suitable to the hospital's own conditions.
Health Phys. 104(2):179–150; 2013

Key words: International Atomic Energy Agency; International Commission on Radiological Protection; radiotherapy; risk analysis

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The authors declare no conflicts of interest.

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(Manuscript accepted 3 July 2012)

INTRODUCTION

The interest in patient safety related to radiotherapy treatments is continuously increasing due to the ever-growing number of patients, facilities, and therapeutic indications. An additional challenge is posed by the complexity of new technologies and techniques, for which the traditional exhaustive lists of tests may no longer be feasible and "expert intuition" may no longer be as effective to perceive when something may be wrong, as it was with conventional radiotherapy. Lessons learned from published information on accidental exposures in radiotherapy are instrumental in ensuring that similar events become very unlikely in the future. Using lessons from past major events to improve radiotherapy safety is usually called the "retrospective or reactive approach." Examples of such lessons are available, for instance, from ICRP (http://www.icrp.org/educational_area.asp) (2002) and IAEA (1998, 2000, 2001, 2003).

"Reactive approaches" may, however, not be sufficient, as new errors not foreseen from past lessons keep occurring (Peiffert et al. 2007). It is therefore necessary to obtain further information from more frequent types of errors that otherwise may go unreported. An important step in this direction has been taken by sharing "near misses" or events that did not have consequences for the patient but have the capacity to cause harm on another occasion or in another place. An example is given by the radiation oncology safety information system, ROSIS (www.eln.radfys.lu.se/default.asp).

While sharing "near misses" is an important step, it still has the limitation of being confined to reported experience. Other latent risks may remain unaddressed unless the questions of "what else could go wrong?" or "what other hazards might be present?" are posed in a

Initiator Event	
Code:	AL-PAC6.1
Name:	Patient identification error during preparation of treatment plan. Treatment plan for a patient prepared with data from another patient.
Treatment Modality:	Linear Accelerator
Phase in the process:	Volume delineation
Process sub-phase:	None

Default Risk				
FL	PH	CH	=	RH

From the list bellow, choose those barriers and reducers that are implemented in your facility:

Frequency reducers	
☐	Maintaining the working conditions of the radiotherapy technologist such that concentration and avoidance of distraction is fostered
☐	Moderate workload
☐	Safety procedure for patient's verification and traceability of history purposes

Barriers	
☐	Joint dosimetric plan evaluation by the radiation oncologist and the medical physicist
☐	Participation of the radiation oncologist, medical physicist and radiotherapy technologists, in patient positioning and immobilization for initial treatment session
☐	Participation of the radiation oncologist, medical physicist and radiotherapy technologists, in patient positioning and immobilization for initial treatment session
☐	Portal image taken during the initial treatment session for evaluation by the radiation oncologist and the medical physicist, whereby geometric treatment errors can be detected
☐	Review of the delineated volumes and organs at risk by the radiation oncologist
☐	TPS Patient identification system with unique identification (ID) number
☐	TPS patient identification system, which provides a unique identification (ID) number for each patient
☐	Verification of the PTV location by checking that the actual SSD and the table top to isocenter distance coincide with the values indicated in the treatment plan

Consequence reducers	
☐	At the daily patient setup, the radiotherapy technologists can detect geometric or dose errors by visual signs, such as skin reddening, etc.
☐	Weekly medical evaluation of the patient can detect errors in treatment delivery or from previous stages
☐	Weekly portal image, with which geometric errors can be detected

Compute risk level

Get the report of its current assessment

Would you like to analyze your entire radiotherapy service?

2 RISK MATRIX - SEVRRA

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Subject Classification: 0103-Medical physics (including dosimetry)

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3 MARR – RISK MATRIX IN SPAIN

OBJECTIVES

- **Training** of Hospital professionals in the Risk Matrix methodology applied to radiotherapy.
- **Pilot application** of the Risk Matrix methodology in significative radiotherapy services in Spain.
- **Development of guidelines** to help and guide the application of the methodology and its homogenization.
- **Guidelines** and methodoloty **difffusion.**

3 MARR – RISK MATRIX IN SPAIN

PARTICIPANTS

Sociedad Española de Oncología Radioterápica
(Asunción Hervás Morón – H. Ramón y Cajal)

Sociedad Española de Física Médica
(José Miguel Delgado – Hospital 12 de Octubre)

Sociedad Española de Protección Radiológica
(Carlos Prieto – Hospital Clínico San Carlos)

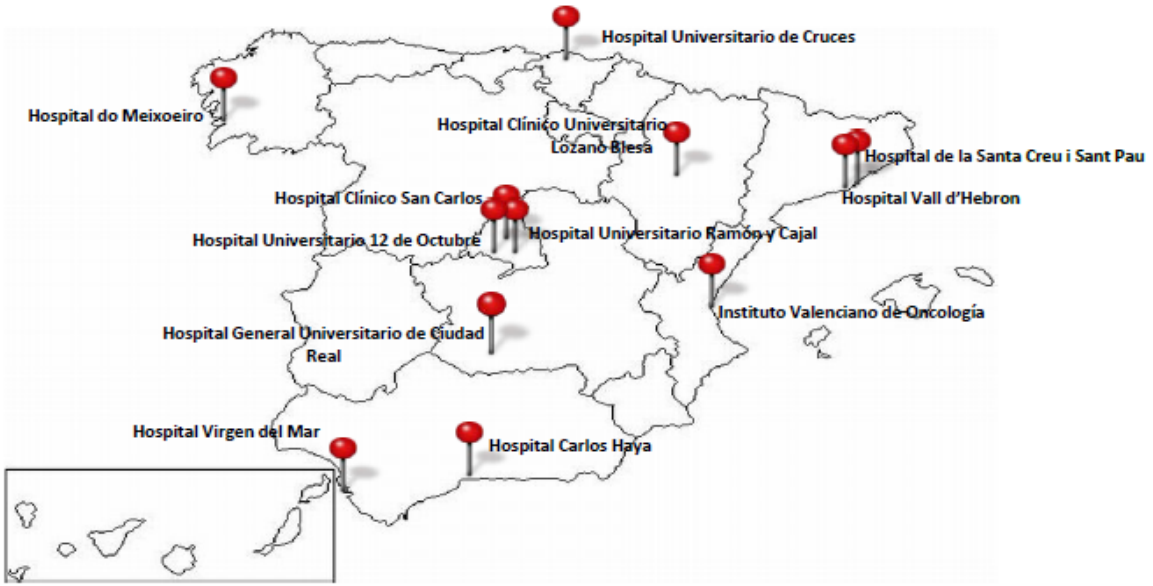
Asociación Española de Técnicos de Radioterapia
(Pilar Crespo – Hospital 12 de Octubre)

Consejo de Seguridad Nuclear
(IREM / SRO)

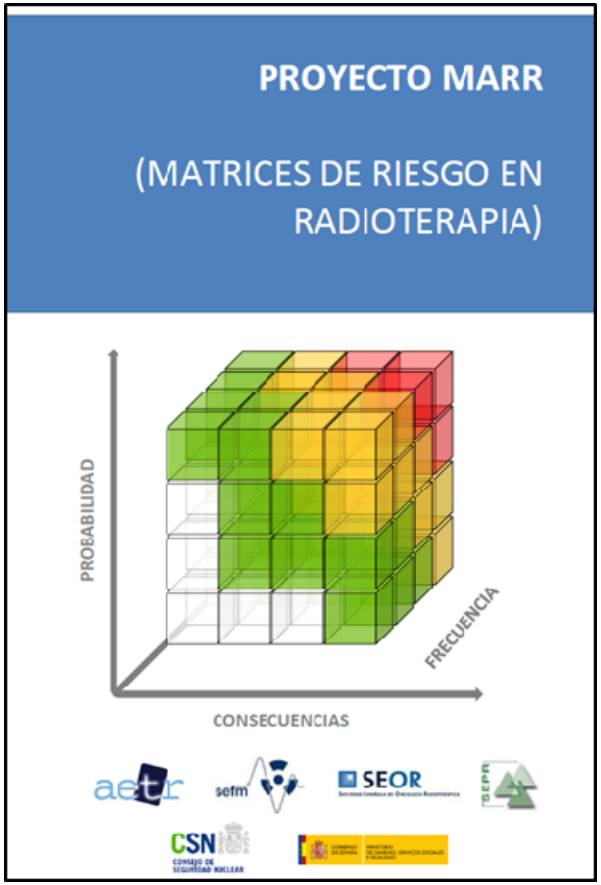
3 MARR – RISK MATRIX IN SPAIN

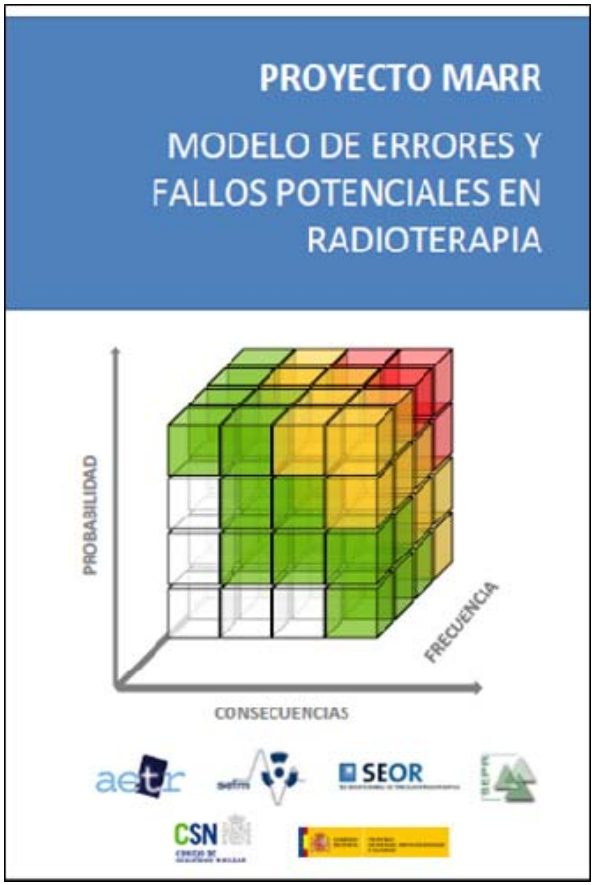
PARTICIPANTS HOSPITALS (12)

- Each team comprised by, at least, a Radiotherapy Oncologist, a Medical Physicist and a Radiotherapy Technician



3 MARR – RISK MATRIX IN SPAIN





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4 SAFRON

http://rpop.iaea.org/SAFRON

Information for
Health Professionals
Member States
Patients and Public

Social Media

facebook

RPOP
Like Page

RPOP on Twitter

SAFRON

IAEA | SAFRON Safety Reporting and Learning System for Radiotherapy

What is SAFRON

SAFRON, Safety in Radiation Oncology is an integrated voluntary reporting and learning system of radiotherapy incidents and near misses. The main goal of SAFRON is to improve the safe planning and delivery of radiotherapy by sharing safety-related events and safety analysis around the world.

Information submitted is dependent on facilities registering and sharing incidents that occur in their institutions. Having started in December 2012, SAFRON has over 50 registered radiotherapy facilities and hospitals all over the world. The system has over 1300 radiotherapy incident reports covering various types of incidents including errors and near misses.

To access SAFRON, users need to be registered with NUCLEUS. To contribute to SAFRON reporting, users need to register with both NUCLEUS and SAFRON. A self-study instructional video is available in the section entitled "User Instructions" below.

Access to SAFRON is here: http://rpop.iaea.org/SAFRON

SAFRON aims to:

SAFRON FAQs

SAFRON Registration instructions

SAFRON Self-Study Training

Related Links

Access to SAFRON is here: http://rpop.iaea.org/SAFRON

SAFRON aims to:

- Promote patients safety in radiotherapy facilities by learning about reported events in an effort to reduce the likelihood of the events being repeated.
- Assist radiotherapy facilities in promoting safety culture and improving patient safety through analysis of near misses and incidents.
- Establish a database of radiotherapy safety related resources.
- Provide users with the ability to analyze and benchmark safety improvement efforts.

Features of SAFRON include:

- A simple way to submit information on near misses and errors that occur in a radiotherapy facility
- Open source capabilities for reviewing incident reports
- Learning about near misses and events in an effort to educate and improve radiotherapy safety
- Central location of related documents and links of safety related peer reviewed articles and reports
- Ability to perform statistical analysis on reported events for both the contributors and the viewers. For the contributors the ability to perform extensive analysis of their facilities reports, benchmarking capabilities to compare own incident reports against all submitted incident reports

User Instructions

Self-Study Training
This instructional video explains how to use SAFRON as a viewer/contributor and guides you through specific

Related Links

- Training material:
  - Radiotherapy
  - Accidental Exposure
- Information for:
  - Health Professionals
  - Patients and Public

IAEA | SAFRON Safety Reporting and Learning System for Radiotherapy

Select Dataset: All incident reports

Home | Process Steps | Incident Reports | Documents and Links | Statistical Reports | Help

Implementing Bonn Call for Action No. 7

"Improve prevention of medical radiation incidents and accidents" via learning from the return of experience of safety related events in medical uses of radiation, and implementing effective risk analysis methods

Featured Incident Reports

Vertebral body adjacent to the target vertebral body received therapy administration.

Auto fusion software was ""zoomed in"" to the incorrect vertebral body, as set up by therapist. The error was found upon review by physicist on May 20th and the 2nd and 3rd treatments were reviewed...

Wrong vertebrae treated

The patient had been treated previously to T6-T8, and we wanted to treat T10-T12. The plan was to set up to the old tattoo and shift 6.5 cm inferiorly. The shift did not happen and the field wound...

Featured Documents & Links

Impact of setup error and anatomical change on dose distribution during conventional radiation therapy

Publication on treatment setup and the need to reimage or replan when patients have marked anatomical changes.

Quantitative cone-beam CT imaging in radiation therapy using planning CT as a prior: first patient

This study looked at the difficulties of using CBCT for patient positioning because of poor imaging and scatter contamination. By using a correction method using the planning CT the capabilities of...

New User?

Request Registration

Actions

Browse Safety Info by Process Step

Search Reports

Search Documents & Links

See Statistical Reports

View Instructions

Download Reports

For more information on radiation safety, please visit the Radiation Protection of Patients Website (RPOP) at https://rpop.iaea.org/

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Select Dataset: All incident reports

Home | Process Steps | Incident Reports | Documents and Links | Statistical Reports | Help

arch for Incident Reports

can search own/all incident reports by process step, who and how the incident was discovered, specific words in the free text fields, or mbination of these parameters.

ase choose your preferred dataset in the top right corner of this screen. Based on this selection, you can browse your own or all incident reports.

What phase in the process is the incident associated with? SELECT

Who discovered the incident?

How was the incident discovered?

Any word in the free text fields:

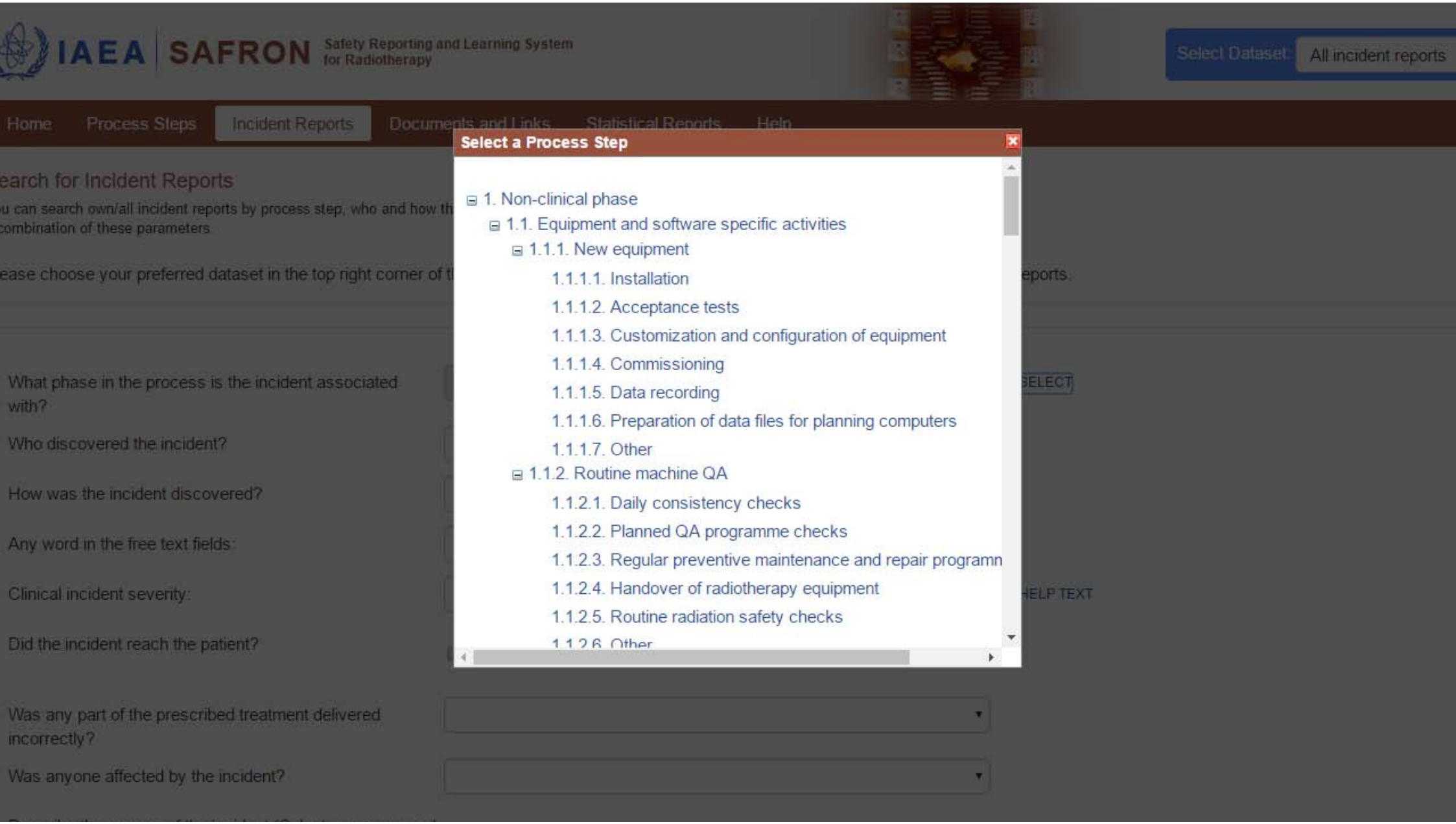
Clinical incident severity: HELP TEXT

Did the incident reach the patient? Yes No

Was any part of the prescribed treatment delivered ncorrectly?

Was anyone affected by the incident?

Describe the causes of the incident (Select one or several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Safety Reporting and Learning System for Radiotherapy
Select Dataset
All incident reports
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Process Steps
Incident Reports
Documents and Links
Statistical Reports
Help
earch for Incident Reports
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combination of these parameters
ease choose your preferred dataset in the top right corner of t
eports.
What phase in the process is the incident associated with?
SELECT
Who discovered the incident?
How was the incident discovered?
Any word in the free text fields:
Clinical incident severity:
HELP TEXT
Did the incident reach the patient?
Was any part of the prescribed treatment delivered incorrectly?
Was anyone affected by the incident?
Select a Process Step
1. Non-clinical phase
1.1. Equipment and software specific activities
1.1.1. New equipment
1.1.1.1. Installation
1.1.1.2. Acceptance tests
1.1.1.3. Customization and configuration of equipment
1.1.1.4. Commissioning
1.1.1.5. Data recording
1.1.1.6. Preparation of data files for planning computers
1.1.1.7. Other
1.1.2. Routine machine QA
1.1.2.1. Daily consistency checks
1.1.2.2. Planned QA programme checks
1.1.2.3. Regular preventive maintenance and repair programn
1.1.2.4. Handover of radiotherapy equipment
1.1.2.5. Routine radiation safety checks
1.1.2.6. Other

IAEA | SAFRON Safety Reporting and Learning System for Radiotherapy

Select Dataset: All incident reports

Home | Process Steps | Incident Reports | Documents and Links | Statistical Reports | Help

Browse Process Steps

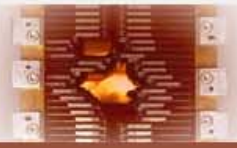
You can view all the process steps for a selected treatment modality.

Please choose your preferred dataset in the top right corner of this screen. Based on this selection, you can browse your own or all incident reports.

All process step for: External beam radiotherapy

- 2.5.2. Positioning of patient
- 2.5.3. Localization of intended volume
- 2.5.4. Production of images
- 2.5.5. Labelling of images
- 2.5.6. Saving and recording of data
- 2.5.7. Other
- 2.6. Treatment planning
  - 2.6.1. Verification of patient ID
  - 2.6.2. Importing of data from external data sources
  - 2.6.3. Choice of technique
  - 2.6.4. Target and organ at risk delineation
  - 2.6.5. Generation of plan for approval
  - 2.6.6. Authorization of plan
  - 2.6.7. Recording of definitive treatment prescription
  - 2.6.8. Calculation for non-planned treatments
  - 2.6.9. Other
- 2.7. Treatment information transfer

IAEA | SAFRON Safety Reporting and Learning System for Radiotherapy



Select Dataset: All incident reports

Home | Process Steps | Incident Reports | Documents and Links | Statistical Reports | Help

View Safety Information for 2.6.1. Verification of patient ID

You can view own/all incident reports and other safety information related to a specific process step.

Incident Reports

Incident Headline	Actions
Incorrect identification of patient	VIEW
Mix up of patients	VIEW

Related Document and Links

No Document & Link record found.

ew Incident Report

u can view incident report details below.

Mix up of patients

reatment modality:	External beam radiotherapy
quipment used:	
ate of discovery:	2008-09-25
/ho discovered the incident?	No information provided
ow was the incident discovered?	Chart check
/hat phase in the process is the incident associated with?	2.6.1. Verification of patient ID
/here in the process was incident discovered?	1. Non-clinical phase
/as anyone affected by the incident?	No, but someone could have been; potential incident
/as any part of the prescribed treatment delivered correctly?	No information provided
rst day of treatment:	
ow many fractions were delivered incorrectly?	

al number of fractions prescribed:	
escribed dose per fraction (Gy):	
elevant, please estimate the dose deviation from the scribed dose per fraction:	
nical incident severity:	No information provided
he incident-cause is related to equipment (hardware or tware), please specify the make, model and version mber:	
scribe the incident in detail:	At the preparation of the new patient at the machine, we couldn't import the patient in Visir. Physicist sends the plan again. We import, but fraction dose and number of fractions are not filled in, monitor units were wrong and no dose calculation performed. We find out that the physicist who, the day before, were responsible for dose calculation had used another patient's plan and protocol. The chart had also been filled in wrong. This physicist was not available, but then we contact today, sends the plan for the correct patient, however no dose calculation was performed. But he had produced 2 protocols, none for our patient. We find out that there were 2 patients at the CT that day with the same diagnosis, and their treatment charts were mixed up. It caused delays, less time to prepare and check. (ROSIS 1224631117)
scribe the causes of the incident:	
l the incident reach the patient?	
at safety barrier failed to identify the incident?	
at safety barrier identified the incident?	
at safety barrier might have identified the incident?	
scribe contributing factors to the incident:	
ggest preventive action(s):	
isk assessment complete?	No

4 SAFRON

MAIN OBJECTIVE

To improve safety through a connection between incidents report (SAFRON) and risk assessment tool (SEVRRA)

SAFRON users have access to:

- Assess the safety robustness of their radiotherapy practice, analyzing the risk level achieved with the safety barriers/reducers already implemented
- Identify safety elements that produce an important risk reduction

4 SAFRON

1206 SAFRON events report were analyzed

Nearly 86% of SAFRON events report match with one or more SEVRRA initiating events

62 SAFRON reports do not have correspondence with SEVRRA IE's:

- Errors associated with Clinical issues (i.e. prescription errors)
- New technologies (i.e. IMRT) out of the current scope

View Incident Report

You can view incident report details below.

Bolus missed at simulation

Treatment modality:	External beam radiotherapy
Equipment used:	
Date of discovery:	2007-02-12
Who discovered the incident?	Radiation therapist/staff at treatment unit treating patients
How was the incident discovered?	Found at the time of first patient treatment during regular checks
What phase in the process is the incident associated with?	3.1.3.4. Use of compensators
Where in the process was incident discovered?	3. Treatment phase
Was anyone affected by the incident?	Yes, one patient
Was any part of the prescribed treatment delivered incorrectly?	No
First day of treatment:	

First day of treatment:	
How many fractions were delivered incorrectly?	0
Total number of fractions prescribed:	
Prescribed dose per fraction (Gy):	
If relevant, please estimate the dose deviation from the prescribed dose per fraction:	
Clinical incident severity:	No information provided
If the incident-cause is related to equipment (hardware or software), please specify the make, model and version number:	
Describe the incident in detail:	In the treatment chart it said that a bolus should be used, but it was not specified. It was missed at the simulator. The patient spent an extra hour at the treatment table, since it was difficult to find anyone with knowledge of the bolus. (ROSIS 1171930472)
Describe the causes of the incident:	
Did the incident reach the patient?	
What safety barrier failed to identify the incident?	
What safety barrier identified the incident?	
What safety barrier might have identified the incident?	
Describe contributing factors to the incident:	
Suggest preventive action(s):	
Is risk assessment complete?	No

Initiator Event	
Code:	AL-PAC6.1
Name:	Patient identification error during preparation of treatment plan. Treatment plan for a patient prepared with data from another patient.
Treatment Modality:	Linear Accelerator
Phase in the process:	Volume delineation
Process sub-phase:	None

Default Risk				
FL	PH	CH	=	RH

From the list bellow, choose those barriers and reducers that are implemented in your facility:

Frequency reducers	
☐	Maintaining the working conditions of the radiotherapy technologist such that concentration and avoidance of distraction is fostered
☐	Moderate workload
☐	Safety procedure for patient's verification and traceability of history purposes

Barriers	
☐	Joint dosimetric plan evaluation by the radiation oncologist and the medical physicist
☐	Participation of the radiation oncologist, medical physicist and radiotherapy technologists, in patient positioning and immobilization for initial treatment session
☐	Participation of the radiation oncologist, medical physicist and radiotherapy technologists, in patient positioning and immobilization for initial treatment session
☐	Portal image taken during the initial treatment session for evaluation by the radiation oncologist and the medical physicist, whereby geometric treatment errors can be detected
☐	Review of the delineated volumes and organs at risk by the radiation oncologist
☐	TPS Patient identification system with unique identification (ID) number
☐	TPS patient identification system, which provides a unique identification (ID) number for each patient
☐	Verification of the PTV location by checking that the actual SSD and the table top to isocenter distance coincide with the values indicated in the treatment plan

Consequence reducers	
☐	At the daily patient setup, the radiotherapy technologists can detect geometric or dose errors by visual signs, such as skin reddening, etc.
☐	Weekly medical evaluation of the patient can detect errors in treatment delivery or from previous stages
☐	Weekly portal image, with which geometric errors can be detected

Compute risk level

Get the report of its current assessment

Would you like to analyze your entire radiotherapy service?

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Risk with barriers and reducers				
FL	PH	CM	=	**RM**

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Process sub-phase:	None

Risk with barriers and reducers				
FL	PVL	CM	=	RL

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Treatment Modality:	Linear Accelerator
Phase in the process:	Volume delineation
Process sub-phase:	None

Risk with barriers and reducers				
FL	PL	CM	=	RM

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INDEX

5 OTHER ACTIVITIES

i. Finished

   a. Industrial Radiography

ii. Starting (2017)

   a. Nuclear Medicine

   b. Advanced Radiotherapy Techniques (IMRT…)

5 OTHER ACTIVITIES – INDUSTRIAL RADIOGRAPHY

1. Mobile Industrial Gammagraphy
2. Mobile Industrial Gammagraphy in a Bunker.
3. Radiography with Mobile X-Ray equipment
4. Radiography with X-Ray equipment in bunker

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5 OTHER ACTIVITIES – INDUSTRIAL RADIOGRAPHY

ACTIVITY	NUMBER OF INITIATING EVENTS	CONSEQ TO WORKER	CONSEQ TO PUBLIC	HUMAN ERRORS	EQUIPMENT FAILURES	EXTERNAL EVENTS
MOBILE GAMMAG.	76	38	38	41	13	22
BUNKER GAMMAG.	70	55	15	42	12	16
MOBILE X-RAY	20	7	14	10	2	8
BUNKER X-RAY	10	5	5	8	1	1