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### **COLLECTIVE ELABORATION OF CARE FOR SAFETY IN RADIOTHERAPY.**

**Cooperative management of patient  
variability.**

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# 1. Aims

This research is about collective production of radiotherapy care involved in cancer treatment. Approximately 1 900 000 patients are concerned with radiotherapy each year in Europe which represents about 60% of patients suffering cancer. Radiotherapeutic approach exposes tumour cells to ionizing radiation in order to prevent their proliferation and to destroy them.

Even if the objective is the destruction of pathological tissues, the negative effects of the rayon on healthy tissues have been described in several cases like the Zaragoza accident in 1990 in Spain or the Epinal accident in France in 2005. Thus to ensure the safety of the care, three parameters are defined with precision:

- the radiation dose, in order to define the “appropriate dose” ;
- the anatomical target area to be irradiated, in order to treat patient with the appropriate dose “provided at the proper place” ;
- the moment of the treatment, in order to treat patient with the appropriate dose apply at “right time”.

The radiation treatment requires the participation of a multiplicity of actors. Its development and administration result from the combination of 4 types of professionals providing their own area of expertise: radiation oncologists, medical physicists, dosimetrists and radiographers. Radiotherapy may be regarded as the outcome of a cooperative activity and all the professionals are in charge of the safety of care. A simplified modelization of the chain including the actors and theirs main functions is exposed in Fig 1.

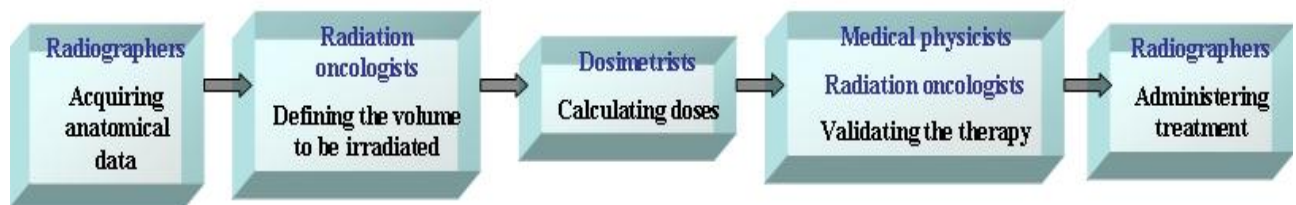


Fig. 1. Modelization of the treatment chain

The aim of this research is to characterize the communicative process between actors to highlight the safety practices carried out to build, and to implement, a safe treatment. Our research is integrated in a large design process involving three software design companies and major French cancer institutes. The aim of the project is to contribute to the design of a sociotechnical system providing a technological answer to the safety of care by supporting the data workflow and the coordination between actors. The study presented is integrated in a more global research which aim is to identify the strategies implemented by the collective to promote the conditions of a safe treatment regarding the technological solutions proposed. We focus here on the radiographers’ activity and in particular the function of the diversity of informal exchanges between these actors who are present at the both ends of the treatment chain.

## 2. Methods

### 2.1. Field

Our empirical research has been conducted in the radiotherapy department of a Parisian cancer institute involved both in research about mechanisms of emergence and progression of cancer, and treatment of patients.

The technical equipment of the radiotherapy unit includes two simulation stations and seven treatment stations. Simulation stations aim at defining patient positioning before the administration of the treatment, which is made on treatment stations. Each treatment station receives from 10 to 40 patients per day. Nearly 80 professionals from different specialties work on this technical platform.

### 2.2. Accessing radiographers' activities at both ends of the treatment chain

35 hours of observations have been carried out to understand the work practices of each professional category. Afterwards, we specifically target radiographers' activity performing semi structured interviews to characterize informal exchanges between radiographers. Interviews cover the following topics that emerged during the observation phase:

- informal annotations written on patients' paper file;
- annotations concerning positioning tools and masks that facilitate the reproducibility of patients position on the treatment table;
- verbal exchanges dedicated to the positioning characteristics of some patients;
- exchanges on the characteristics of a particular patient.

Five radiographers at simulation station and five radiographers at the treatment station were interviewed, covering a range of expertise between 1 and 20 years in the profession.

## 3. Results

### 3.1. Radiographers' activity about patient positioning

The objective for the radiographers is to achieve the anatomical target by providing "the appropriate dose at the right place". This safety criterion implies to properly define the placement of the patient in order to reach the *reproducibility* of the position. Moreover, the *immobility* of the patient on the treatment table during the therapy is also required.

During the treatment process the definition of patient positioning occurs in the simulation phase and the treatment implementation occurs at the end of the process. They are not performed by the same radiographers, which implies that they elaborate various resources to shared information patient positioning. The radiographer at the simulation station is responsible for the definition of patient future positioning during the treatment phase. Anatomical images fixed in this phase are the bases for the construction of the virtual treatment. The position adopted lately by the patient during treatment sessions is defined at this moment. At the end of the chain radiographer at the treatment station installs the patient on the table according to the position previously defined. To verify that the prescribed target is irradiated, radiography images are taken during the first session, and periodically during the

successive sessions. In addition to this image-based verification, patient positioning on the treatment table is involved in reaching the target area.

### **3.2. Cooperation between radiographers to improve the production of a safe care**

Our results show that informal written and oral transmissions between radiographers co-exist with formal ways of communication like patients' paper files and computer tools.

The formal information facilitates the reproducibility of patient positioning: the simulation radiographer transmits information about parameters of patient positioning, including pictures in the patient's paper file. This formal information allows a functional cooperation for the reproducibility of the patient position which is sufficient for treatments that are not concerned by a particular variability, as stressed by interviewees:

*“In typical cases we get out...we use the pre-recorded picture of accessories ... so with positions to marker... the angulation of the arm and all that is already completed ... there are several (pictures), it depends on location”.*

#### **3.2.1. Unusual treatments and variability related to patients lead to informal exchanges**

However, the formal paper file is not sufficient for radiographers to cope with the variability related to difficult or unusual treatments which lead them to use different types of informal exchanges. Thus informal annotations are written on patients' paper file, as stressed by an interviewee;

*“Sometimes we modify a bit the (standard) position, we adapt ourselves to the patient, we must indicate a maximum of information, and we must take pictures and mark the maximum of information so they find the right way (to position the patient)”.*

Shared information may concern some complicated positions or some characteristics of the patient that can impact the reproducibility of the position and the immobility of the patient, such as:

- the patient psychological condition: the patient can be stressed, aggressive, claustrophobic, depressive, possible reactions during the treatment.;
- the patient physical condition: the patient is subject to trembling, painful, physically disabled and cannot adopt easily the defined position;
- the patient inability to understand instructions during the session: a patient not French speaker, blind, short-age child, sick with Alzheimer's.

#### **3.2.2. Informal exchanges allow an anticipated organization of the treatment session**

Exchanges between the two ends of the chain about unusual treatments and difficult patients likely to exceed the allowed time for a session, are been highlighted. Those exchanges allow the anticipation for the proper management of the session.

Two aspects of the session are concerned:

- the temporal adjustment of the treatment session. This allows radiographers to anticipate the favorable conditions for manage the treatment session. The suggestions of increasing the time of the session may favor an appropriate care by preventing the accumulation of delay. That promotes good and safe placement conditions for following patients who are planned in the schedule.

*“ at the treatment stations the delays are already fixed, for example, for a prostate is 10 minutes ... but if the gentleman is painful or he has difficulty to position himself ... they (radiographers at treatment stations) are told to increase the period of time”.*

- the adjustment of the treatment session according to the patient about the instructions that he must follow during the application of the treatment. Adapting instructions to a particular patient may increase the probability that he follows the instructions about immobility.

*“A common patient is explained the course of the treatment but we spend less time... let's say that ...with a patient who is really depressed we'll take the time to explain, the coverage is different”*

Informal communications outlined illustrate cooperation between radiographers at the both ends of the chain. Their objective is to share specific information related to the treatment and related to the patient that may affect the treatment session. Radiographers have to adapt the treatment session in order to prevent bad positioning and in order to increase the probability of an immobile behaviour by taking into account the patient specificities. These strategies for safety production - that concerns the target area to be irradiated- imply to manage the variability related to the patient and is achieved by anticipation between the posts promoting temporal conditions for the reproducibility and immobility of positioning the patient.

## **4. Conclusions**

The situation described above shows that information exchanged by radiographers between both ends of the chain participates in a collective construction addressing the safety criterion "right place" for implementation of treatment. The informal cooperative management of patient variability performed by radiographers and described in this study is closely related with managed patient safety (Amalberti, 2007) that refers to the informal arrangements realized by the operators to produce safety. Faced with inadequate or insufficient formal rules, operators develop informal strategies to manage variability presented by the patient in order to achieve production and safety targets (Terssac, 1992; Nascimento & Falzon, 2008).

A condition to let the group manage safety is the existence of a minimum of knowledge of the activity of other actors: the knowledge concerning the activity of others is presented as a prerequisite for cooperation. In this sense, selection and transmission of information to other radiographers contributes to the collective production of safe care by facilitating the accomplishment of their objectives. As stressed by Leplat (1991), such informal cooperation is based on a mutual understanding of what colleagues do.

According to this, to develop and to maintain situation awareness between the two ends of the treatment chain may contribute to safety by helping operators to anticipate situations that might go against a safety criterion (Salmon, Stanton, Walker, Baber, Jenkins, McMaster & Young, 2008). These issues are essential to guide the design of tools that support the production process, in our case the implementation of a treatment.

In this sense, two issues have to be explored. On a pragmatic side participation to software design supporting activity in radiotherapy implies the identification of the factors of variability actors have to cope with. On a theoretical side, we may explore the following questions: what is involved in the design of a safe system including technology? or what is participating to the safety design?

## References

Amalberti, R.(2007). Ultrasécurité. Une épée de Damoclès pour les hautes technologies. *Sciences à risques. Les dossiers de la recherche n° 26*, 74-81.

Salmon, P.M., Stanton,N.A., Walker,G.H., Baber,C., Jenkins,D.P., McMaster,R., Young, M.S. (2008) What is really going on ? Review on situation awareness models for individuals and teams. *Theoretical Issues in Ergonomics Science*, 9(4), 297-323.

Leplat, J.(1991). Organization of activity in collective tasks. In J.Rasmussen, B.Brehmer & J. Leplat (Eds.) *Distributed decision making: Cognitive models for cooperative Work*, 51-74. New-York (U.S.A) : John Wiley & Sons

Nascimento, A. & Falzon, P.(2008). Risk management in Radiotherapy, in L.Sznelwar, F. Mascia and U.Montedo (Eds.) *Human Factors Organizational Design and Management*, IX, Sao Paulo, 19-21 mars 2008.

Terresac, G. de (1992). *Autonomie Dans Le Travail*. Paris (France) : PUF