This paper reports a case study developed in the radiology sector of a hospital in Natal- RN with the aim to carry a survey on its ergonomic demands, as well as to identify which activity determiners are operating in this area. In order to perform such task it was used a methodology based on ergonomic analysis of work - AET (Guerin, 2001; Vidal, 2008; Wisner, 1987). The research was developed in a participative way through situated observation of the work activity, conversational action and verbalization. It also stems from a preliminary theoretical research which pointed hypothesis of demand. The results show the factors which have negatively influenced the security of operators, such as: disuse of individual protection equipment; vast amount of defected images generated which leads to re-work, thus increasing the exposure of workers and patients; inadequate space in the dark room and in the Record room. The lack of correct isolation in the areas; physiological harm caused by heavy weight of IPE’s. The aim of this paper is to identify the disuse determiners or the inadequate use of IPE’s by operators in the area of radiology. Improvements were recommended in the organization of work, following radioprotection rules, making operators more aware of risks and prevention during their training sessions, the previous explanation to patients about the exam and the relationship with patients.

Palavras-chaves: radiology, ergonomic demands, work ergonomic analysis, occupational security, IPE
1. Introduction

The presence of a radiology sector is extremely important in a hospital, because with this service x-ray exams are made. X-rays are necessary to diagnose several pathologies. With the radiation use, it is possible to photograph any bone and muscular structure in humans and animals.

However, though the benefits radiological exams bring, when it comes to the direction of medical behavior, the exposure to radiation may become a risk to operators and patients' health. For that reason the job of radiology technologist has a high level of insalubrity, compensated by short work shifts, early retirement and insalubrity/periculosity additional payment.

Several works have demonstrated the high turnover level of workers in this sector, caused mainly by long absences caused by illnesses and health problems (MENDES, 2006; PEREIRA, 2008).

In this context, the current article shows a systematized study from the ergonomics point of view, carried out in the Radiology sector of a private Hospital in the municipality of Natal, Rio Grande do Norte and which aims to investigate ergonomic demands as well as identify the activity determiners for the technologists who operate in the radiology sector. In order to do so, observational and intereactional techniques, verbalizations, respectful hearings, photography and videos were used as collection instruments. They were complemented by documental analysis and theoretical studies.

Through the situated analysis of this activity, it was possible to detect aspects related to the physical, cognitive and organizational work system which determines the work conditions to which the agents are submitted. From this analysis it was also possible to identify the ergonomic demands of work situation and perform a hierarchization process of such demands, thus determining in which situations an ergonomic intervention may contribute to that work reality in the radiology sector. Afterwards it was done a focused study, which allowed the design of work situation model, specifying aspects which can be improved and how to apply those changes.

The current study justifies itself in that reality by the importance of suggesting alternatives which can minimize work repercussions for operators and make them aware of the existing risks.

2. Theoretical reference

Radiology started being known in 1895, thanks to Wilhelm Konrad Roentgen’s invention, who was repeating the experiment of another scientist called Philipp Lenard, and observed that cathodic rays would escape from a vacuum tube by a narrow aluminum opening and then would produce luminescence in fluorescent salts and a consequent darkening of a photographic plate. From the quick disacceleration of electrons, our familiar x-rays appeared. These rays are used in the medical area to visualize images of our body such as bones, organs, vases, etc (RADIOLOGIA, 2007).

The work developed in the x-ray sector comprises factors which are intrinsically related to work security. That occurs because radiation is a physical agent which generates insalubrity in its maximum level and periculosity, for the damages which may be caused to health in a short, medium and long-time. The consequences of exposure to radiation are many, and they range
from cancer, hereditary genetic mutation (albinism, color blindness, hemophily), necrosis, radiodermatitis, sickness, headaches among others. In order to inhibit the appearance of such unwanted diseases or symptoms, it is necessary to use some equipment and behavior. These elements are responsible for radioprotection (MENDES, 2006).

Ergonomics is defined by Laville (1977) as "the group of knowledge concerning man’s performing a certain activity in order to apply them to the conception of tasks, instruments, machines and production systems”. The definition can be used as a tool to analyze radiologists work. The knowledge of ergonomics and Ergonomic Job Analysis (EJA) are essential for a situated analysis of the activity and contributes to understanding the variabilities and regulation that appear during productive process.

A study carried out by Carvalho et al (2007), shows the application of an EJA in an ergonomic action to improve radiological process in a hospital, where it was observed the existence of some constraints that could affect operators health and quality service of images produced such as: no door locks; damaged equipment, high film loss and re-work which increase occupational and patient exposure; few pauses during work shift; lack of specific operational training; intensifying work shift; fatigue; stress and other factors.

In a research developed with radiology technologists in a public health institution in Florianopolis, the results of Morawski (2007) showed the disuse of radiological protection, no control on image quality and the absence of any instructions on the exam to the patients.

Polleto et al (2007) have stated as some aspects of the demand in a public hospital, the age, weight and low quality of radiological equipment in use. They also pointed that during the execution of excessive movings, the small amount of IPE’s for workers and the lack of information on protection norms.

When analyzing the activities developed by radiology technologists in their sector according to the rules work security, Pereira (2008) also shows that the exposure to chemical and physical agents during the several steps of the process demands the use of individual protection equipment. Besides that, there are also biological contamination risks during the phase in which the patient is moved to do the test. There are also ergonomic risks in the work environment.

From theoretical approach, it is possible to obtain the necessary details to design model of work analysis where the contact with the activity is featured as verification of constructed hypothesis, a way which requires a path contrary to the one used in social sciences (ABRAHÃO, 1993).

The same author completes by saying that with technological and scientific advance and its consequences, mostly the ones related to the change of the nature of the task and also to the required competences, work has been transforming itself structurally, which demands an even more accurate understanding of the relationship operator instrument-task.

The methodology of Ergonomic Job Analysis (EJA) allows the understanding such relationship. It is the fundament which supports the relationship between Ergonomics theoretical reference and its character of an applied subject. It is features as a structures group of intercomplementary analysis of the determiners in people’s work activity in an organization. With the use of many methods and techniques it is possible for the professional to understand his object of investigation and its acting scope. It is understanding the relation of work activity and its context (environmental, technological, organizational) and make the necessary changes to operate a positive transformation (VIDAL, 2008).
In that sense, EJA has as one of its aims to construct activity models for man at work. According to Amalberti (1991), this ergonomic model refers to a precise work situation which has new cognitive, situational and organizational demands.

3. Methodology

The methodology used in this paper was based on Ergonomic Job Analysis (EJA) (Guérin, 2001; Vidal, 2008; Wisner, 1987), which was developed in steps, during the case study of the radiology sector in a hospital in Natal.

In the current paper, the demand was not spontaneously presented by the company, so it was elaborated from the intention of the researcher in order to obtain the ergonomic demands in the radiology sector. That is why it is called an induced demand (CARVALHO et al, 2005; SALDANHA, 2004; VIDAL, 2001; 2008;).

Beginning with theoretical research based on a referential situation, it was possible to formulate demand hypotheses that are present in the work activity in the radiological sector. Basing itself on social construction, it was developed a global analysis using observational methods (open and oriented observations) and interactional (structured interviews, widened hearing, conversational action and verbalizations) which were all applied during six visits to hospital. From global analysis it was possible to identify latent and managerial demands. Latent, managerial and induced demands were confronted in a process of mutual demand construction, thus allowing the appreciation of ergonomic demand.

3.1 Social Construction

The process of demand instruction began with the creation of a sustaining structure in the company, which could assure the success of such instruction and had as a goal the harmony of recommendations given within the context of the organization for it is necessary that those are measurable and possible to be made (VIDAL, 2008).

The device of social construction applied at the hospital enabled the study to be developed from the dialogue of researchers with the people involved, confronting them with the models of activity generated by the study in its several moments. The composition of groups and the scheme will be described as follows:

–Ergonomic Action Group (EAG): formed by people responsible for ergonomic intervention. It is composed by the articulation of the external research team, production engineering graduation students and those responsible for work security in the hospital;

–Support Group (SG): formed by people who have the power to make decisions in the hospital that means the hospital director and the medical department director;

–Accompany Group (AG): formed by a professor from the production engineering course and co-advisor of the research and also by people who have authority to make decisions directly on the sector of radiology and image in the hospital;

–Focus Group (FG’s): formed by the agents directly involved in the radiology sector – technicians and interns who work in the sector;

–Privileged interlocutor: A privileged interlocutor worked together with the EAG allowing a bigger contact with the teams in hospital, thus facilitating the obtention of relevant information to the study. These information were about the company, the radiology sector and the acting area of technicians (principles, norms).
Social construction has promoted permanent contact with a significant fraction of the company who is also related to the process of demand instruction.

### 3.2 Hypothesis of induced demand

Preliminary studies performed in the beginning of the research have showed, from former investigations performed by other authors, qualitative data which enabled an analysis of the relationship between radiology technician and his work post. Such data were used to design the following hypothesis of the induced demand:

- Absence of plumbing isolation in the doors (CARVALHO et al., 2007);
- Presence of chemical, physical, biological and environmental risks in the workplace (PEREIRA, 2008);
- Damaged work equipment, old, heavy and with poor quality (CARVALHO et al., 2007; POLETTO et al., 2007);
- Disuse of individual protection equipment because of lack of knowledge or enough equipment to all work population (MORAWSKI, 2007; POLETTO et al., 2007);
- Rework and great losses of film (CARVALHO et al., 2007, 2008);
- No control on the quality of images produced (MORAWSKI, 2007);
- Lack of specific training for workforce (CARVALHO et al., 2007; POLETTO et al., 2007);
- No previous instructions to patients before exams are made (MORAWSKI, 2007);
- Intense working time pauses (CARVALHO et al., 2007).

### 3.3 Global analysis

The following step is the global analysis of the situation, which allows the previous hypothesis to be proved or not. Given the singularity of each situation, other determining factors in the work activity will be mentioned and they will configure themselves as latent, managerial or workers’ demands which were not covered in the studies of the theoretical context.
reference and, therefore, they did not take part in the hypothesis construction process for induced demands.

Managerial demand had its focus on the waste of material and the costs that follow that problem. As latent demands we mentioned the lack of space and the random distribution of equipment in the record room, which made technicians adopt a critical attitude and also the lack of several IPE’s which were not offered by the hospital to be used by operators.

3.4 Ergonomic Demand

With the data obtained in the field, it was noticed which are the main determiners of the activity of technicians work. Among these factors there was one constant and noticeable attitude by operators in the work developed in the sector: the ineffective use of radiological protection. Based on that and during the process of mutually constructing the demands, it was defined to the study the following ergonomic demand: to mold a more favorable situation for using the radiological protection gear by work staff which make it possible to decrease occupational exposure of them, as well as adopting measures to decrease the amount of rework (which occurs mostly in exams done with children), thus considerably minimizing the risks and damages to the workers’ health.

4. Case study in the radiology sector in a private hospital

The current paper was developed in the radiology sector of a private hospital located in the south area on the municipality of Natal, Rio Grande do Norte. The hospital was officially founded on 12/12/1969 and started its activities as a pediatric emergency room. As time went by it broadened its services and nowadays it is a general hospital which works with all specialties in general practice and emergency 24 hours a day.

4.1 Global analysis of radiology sector

The radiology sector of a hospital works 24 hours a day, either in urgencies which have to be solved in a short time, in emergencies, when the patient needs immediate service and also doing previously booked exams. The hospital is equipped with mobile machines for specific situations. In order to guarantee its 24 hour service, in the hospital a day is divided in six four hour shifts, without any prescribed pauses. The shift which was chosen for this study was the first afternoon shift (11a.m. to 3 p.m.), for besides being the peak hours, which we noticed in the first analysis, one of the operators of the shift is acquainted with the team, which provided the presence of a privileged interlocutor to facilitate obtaining information and articulating with several groups in the organization.

The shift which was studied (11 a.m. to 3 p.m.) has five technicians and three interns, who work four hours a day, seven days a week. The technicians have been working in the hospital for thirteen years and their beginning of career in radiology happened by chance. They acquired experience from older technicians, through internal training which were not formally specialized or recognized, for at that time there was not a specialized course in the city. All of them are submitted to general exams every six months, as well as the determining of radiation amount absorbed during this time. That periodic medical evaluation is determined by NR7 – PCMSO (Program of Medical Control of Occupational Health), (BRASIL, 1992).

At the moment technician who did not have any qualification certificate are attending to a radiology technical course in order to be registered professionally according to the new employment rules of the hospital. The course qualifies them to perform traditional radiographs, develop radiological films, prepare chemical solutions, give instructions to the patients and organize the ambient for the exams in radiology. All of these topics follow the
principles of radiologic protection. The interns are also taking part in the course and it was from their experience in the course that the chance appeared for them to get a job in the hospital as part of an internship program. The table 1 below shows a summary of general characteristics and data from operators in the radiology sector.

<table>
<thead>
<tr>
<th>Professional</th>
<th>Age</th>
<th>Sex</th>
<th>Scholarship</th>
<th>Experience</th>
<th>Home</th>
<th>Net Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technician 1</td>
<td>40</td>
<td>M</td>
<td>Incomplete Technical</td>
<td>13 years in hospital; 2 years in radiology area.</td>
<td>North Zone</td>
<td>R$: 1,162,00</td>
</tr>
<tr>
<td>Technician 2</td>
<td>42</td>
<td>M</td>
<td>Incomplete Technical</td>
<td>13 years in hospital; 18 years in radiology area.</td>
<td>North Zone</td>
<td>R$: 1,162,00</td>
</tr>
<tr>
<td>Intern 1</td>
<td>22</td>
<td>M</td>
<td>Incomplete Technical</td>
<td>1-month internship; 1-year and six-month course.</td>
<td>Downtown</td>
<td>-</td>
</tr>
<tr>
<td>Intern 2</td>
<td>25</td>
<td>F</td>
<td>Incomplete Technical</td>
<td>5-month internship; 1-year and six-month course.</td>
<td>South Zone</td>
<td>-</td>
</tr>
<tr>
<td>Intern 3</td>
<td>24</td>
<td>M</td>
<td>Incomplete Technical</td>
<td>3-month internship; 1-year and six-month course.</td>
<td>Downtown</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 1 - Data of work population in the radiology sector of hospital in the shift from 11:00 a.m. to 3:00 p.m.

The task to be done by operators consists of: analyzing doctor’s prescription; taking the necessary x-rays; developing the film; checking the quality of the exam so that the doctor can see well. Real work done by operators is performed according to this sequence: when the patient comes, the radiologist reads the doctor’s prescription, checks if the patient is in the adequate state (depending on the kind of exam) and asks the patient to remove all metal objects he might be wearing and which may damage the final result. The floating table is covered with paper for hygiene reasons (Pic. 3) and then he patient is positioned accordingly on the table or on the bucky (vertical structure used for standing up exams), depending on the need. Having selected the chassis and the right film, the film is put into the chassis, which is placed in the machine. The technician then places the machine on the right area on the patient, puts on the IPC’s (Individual Protection Clothing) and IPE’s (individual protection equipment; there are security goggles, protection gloves, shoes, legs, thermoluminescence dosimeter (TLD), apron, gonad protection and skirts- which are both made of lead; they follow this procedure themselves and also in patients whenever necessary (this stage is not always followed by all operators) (Pic. 2) they control the radiation level on the control panel time and then finally does the radioactive shot with the machine (Pic. 5). After all these steps, the patient gets dressed (if necessary) and waits outside the x-ray room while the film is developed in a special machine in the darkroom and another technician awaits in the record room for the result to be labeled and indentify the film to check if the exam was well made (Pic. 4), otherwise all the process will be repeated until a good image with the right quality for medical diagnosis.
During the exam, any mistake in the “image artifacts” (negative, radiation level, metal presence, exposure, etc), may cause flaws in the image generated. That can cause, among other problems, the waste of material, which is constant in the area and is the main focus of managers’ complaint – and that constitutes a managerial demand. The issue of material waste was mentioned by Carvalho et al (2008), and is one of the hypotheses of demand.

The record stage is carried out in a very small room next to the exam room. The distribution of equipment in the room is randomly made, which makes the technician keep inadequate postures in several moments and for long periods of time throughout his working time. Such problem was not reported by workers or managers, which made the team identify it as a latent demand. Another latent demand which was found was the lack of IPE’s, once the hospital does not offer all kinds of necessary protective equipment, so technicians undervalue radioprotection procedures.

Some technical variabilities observed in the activity of x-ray operators were:

– **Number of prescription by patient**: More experienced doctors usually give the diagnose without the use of x-rays; the least experienced ones, besides needing exams to diagnose, many times ask for x-rays of several parts of the body. That creates a certain instability in the work routine and it means that depending on the doctor who is on duty in a certain moment, technicians may either work a lot and under time pressure or work very little. As a consequence, operators adjust their available time in order to perform the job to their personal conditions, increasing or decreasing their pace according to each situation.

– **Physical type of patients**: this variability concerns the regulation of radiation levels according to each patient, considering his physical type. The heavier he is, the higher level of
radiation will be necessary to pass through his body and reach the bone structure. For a child, the level is much smaller than for an adult. This regulation is made through the experience of each operator, once the only reference table ever to be made was based on an average-sized person.

–Estate of patients: depending on the emotional or physical estate of patients at the moment of the exam, operator must act differently. For example, when a patient has an exposed fracture to be radiographed the situation demands a very careful handling at the moment of placing the patient for the exam. If the patient is a child who is crying, it is necessary to give more attention until the kid calms down so that no movement occurs during the exam, otherwise the image will be blurred and rework will have to be made;

–Objects and clothing with metal on the patients: the presence of metal on a patient during the exam will generate a bad x-ray and it may also cause future damages to the patient’s health (a “spot on the bone” as technicians say). However, not every patient knows about that. The technician must guide the patient previously about removing all rings or clothes that contain metal. If it is necessary to take off the clothes, the patient is taken to a changing room and receives a chamber (hospital apron) to wear.

With the global analysis, it was also possible to identify some normal organizational variabilities observed in the work activity of x-ray operators:

–More than one companion entering: in case of children patients, it is allowed for an escort to come in. However, if the child is in a state of shock, as it was mentioned previously, technicians may permit (wrongly) that both parents or responsible people come in, and provide the right IPE’s for them.

–Lack of prescribed breaks: the work of radiology technicians does not have breaks during the four-hour working time. The studied shift was from 11 a.m. to 3 p.m., which represents lunch time, usually around midday. As workers have no prescribed break for lunch they need to eat before 11 a.m. or after 3 p.m., or even leave the job during the normal pauses (interval between patients).

5. Results and discussions

With the information collected during global analysis it was possible to confirm all hypothesis of demand which had been found during the theoretical research, as well as analyzing determining factors of managerial demand and also the latent demands which were found.

Excessive exposure to radiation by operators was confirmed through the situated observation and data evaluation on the health of agents from the sector. Therefore it was possible to confirm the inadequate use of protection equipment. Most of the times operators use only the apron, or at most, the apron and gonad protectors, and in some situations they use nothing. When asked about this situation they reported:

—“It’s heavy, ugly and we have no time” (Intern 2 - woman)
—“It won’t do any harm” (Intern 1)
—“Once you can’t see, you have no idea of danger” (Technician 1)
—“It’s not necessary to wear all that, just staying behind the lead protection wall will do” (Intern 3)
—“If only you could feel it, touch it or see it, we would be afraid of, but as we can’t see…. ” (Technician 2)
During the analysis it was possible to observe that sometimes, when two patients come at the same time, or in peak hours, there is really no time to wear the IPE’s. Operators could ask the patient to wait for a minute while they put on the equipment, but they prefer not to do so, mostly when the patient comes in a very altered emotional state, such as a kid crying, or with serious injuries that need immediate help.

It was also possible to observe that interns do not believe on the knowledge they acquired during the technical course, even having contact with specific subjects on occupational security such as radioprotection, the practice of this knowledge does not occur. That happens because, among other factors, the short-term symptoms of radiation that operators feel are not believed to be a result of their exposure.

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“There are days when I come home with a headache, but I don’t think it is related with radiation” (Intern 2 - woman)

“If you look at the technicians who work here, they are all bald and they don’t know why” (Intern 1)

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Once radiation is an invisible physical agent, it does not cause any worry from the workers. Another serious aspect of this issue is that two technicians who did not attend to the course when they started working have adapted to that inadequate routine and they influence the interns who, even having studied radioprotection as a subject, prefer to reproduce incorrect radioprotection procedures for they lack practical experience.

In relation to the constraints found in the physical work space it is highlighted: badly distributed physical space, noise and poor lighting.

The physical space of exam room is adequate but the darkroom and the record room are too small, having been designed for one person to work in each room. However, there are many situations which demand more than one person to work in them simultaneously, which is inadequate for their small size.

Another factor related to the physical ambient which was possible to be observed from the speech of the operators was the poor lighting. During the x-ray, it is necessary to have little light in order to frame the beam on the right spot on the patient’s body, but there is no device to turn off the light automatically before the exam. Because of that operators prefer to leave the light off during the morning shift, which causes them to have an optical effort caused by the momentary change from a darker room to brightly lit one (such as a corridor, for instance). Once the eye is used to a dark place, it becomes more sensitive than the eye which is used to light (IIDA, 1990).

About the physical, cognitive and organizational work systems it was possible to identify:

–Physical: physiological stress caused by the absence of prescribed breaks, by the use of heavy IPE’s (the lead apron weighs 2,5 to 7,0 kg) and by inadequate postures;

–Cognitive: The skill of operators to regulate the control panel for the exam according to each patient; decision making for every situation (unpredictable) of the patient (each case is a different case); deciding how to obtain the best image for an accurate and correct diagnosis;

–Organizational: Absence of work division, operators share tasks among themselves without any criteria; lack of production and inspection rules about what is or is not occurring in the x-ray room.

5.1 Recommendations for improvements in radiology sector
From the determiners, the analysis of work activity as well as its variables and dysfunctions has allowed to highlight aspects which should be worked according to the established ergonomic demand, allowing an improvement in the security of workers in this sector.

Firstly, in order to create a more positive situation for adopting preventive procedures, including the adequate use of IPE’s in the sector it is necessary:

–Permanent awareness and training of operators about the existing risks and their consequences and also the importance of adopting the correct procedures and the use of IPE’s to minimize the repercussion of the activity on the health of operators;

–Dimensioning employees in shifts according to patient demand and the activities done by the operators, which require an activity analysis;

–Creating strict rules for procedures and the use of IPE’s, to be established according to the analysis of activity and with constant supervision. That will make them compulsory items as recommended in the Norms;

–The exhibition of explaining banners in the work environment so that operators are constantly exposed to information about radioprotection and the consequences of its disuse;

–Elaborating a map of risks, which is compulsory, according to Anexo IV of NR-5, which considers ionizing and non-ionizing radiations as physical agents with security alert in the obligatory areas. Therefore it is possible to identify areas with higher exposure level and to avoid individuals who are not protected to pass in these places. The methodology of elaborating a map of risk is a space for discussing and understanding by the workers on the risks that exist and the need to adopt protection measures. Once the results are ready, workers from other areas should be involved so as to promote a collective awareness on the existing risks in the radiology sector;

–Redesigning the table which contains the data from instruments to configure the machine, so that it becomes possible to record radiation levels, exposure time, constraint, etc for the greatest number of physical builds;

–Avoid radiological over-exposure by operators and companions because of rework caused by bad images through maintenance of work conditions and machines, moving patients, mainly kids at the moment of the exam and the use of clothing/objects that contain metal.

6. Final Considerations

Ergonomic Job Analysis is a comprehensive method which offers a view on what happens in a production process or in the use and handling of systems. It is the methodology for performing ergonomic studies in order to provide elements for a positive transformation of labor reality (VIDAL, 2008).

The process of instructing an induced demand used in this paper has brought along the challenge to find hypothesis of demand which facilitate the process of social construction and, that can guide the elaboration of interactional instruments to be used in the global analysis and that were fundamental in the ergonomic demand definition to be worked with: over-exposure to risks due to the disuse of inadequate use of IPE’s.

It was important to observe that the occupational security determiners are not related only to work itself, with the presence of physical and chemical agents, but, to the conditions under which the activities were and are being planned and organized, which constitutes the attitude determiners to be adopted by workers and which can become a serious aggravating factor to
work-related diseases.

It was also observed that the lack of information on work security, by both technicians who learned from experience and interns who attend to technical radiology courses. Such conclusion was reached by observing procedures used by operators and by the statements collected during conversational actions and confrontations, when a female intern said she does not wear IPE because it is ugly, and a male intern said he did not use it because he does not think it is necessary and also by a technician who said: “It’s because you don’t see it, then you have no idea of how dangerous it is”.

The absence of any effective accompaniment and supervision by the students who are interns, has contributed for them to reproduce the inadequate procedures adopted by more experienced operators, which more often than not, come from the regulation of normal or unpredicted variabilities in order to fulfill exam demands, either for lack of knowledge or awareness, as it was described previously.

The approach of Ergonomics applied to Production Engineering may interfere in radiological work in several ways. From the technical point of view, it is possible to modify physical aspects of work (redesign the layout, adjust machines and interfaces). In the production planning it is possible to help creating a more uniform flow, avoiding stress and fatigue.

In the administrative part, it is possible to revaluate the norms of the institution and to implement a management program entirely based on the activity analysis. The implementation of such changes may contribute to a better reliability by operators at their work as well as reduce the constraints and dysfunctions of the system, minimize waste and at the same time increase patient’s security when taking an x-ray.

References


