

# HOME RADIOLOGY ACTIVITIES IN ASL BT AS AN EXAMPLE OF INTEGRATION BETWEEN HOSPITAL AND TERRITORY. FUTURE PERSPECTIVES IN THE LIGHT OF PNRR.

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**KEYWORDS:** home radiology, PNRR, ASL BT

## ABSTRACT

The National Recovery and Resilience Plan (NRP) is a plan approved in 2021 to relaunch the economy after the COVID-19 pandemic and provides for an investment and reform package divided into six Missions, including Health. The recent pandemic has clearly demonstrated how the Hospital/Territory axis has not been able to withstand the impact of an event such as the COVID pandemic. With a view to an overall improvement of the system, the PNRR gives us the opportunity to intervene by completely redesigning the territorial health and the goal is to compensate for the current territorial care inequalities and bridge the distance between the traditional places of care and the daily life of the patient, strengthening the health and social health network in the territory with better primary care services. In this context, Home Radiology, a branch of radiology, is inserted, which deals with all procedures aimed at performing traditional radiographic examinations at the home of the non-ambulatory and / or non-transportable patient on the basis of clinical evaluations.

To validate the activity of Home Radiology, in this experimental study, radiographic examinations performed at home were compared with radiographic examinations performed in the hospital with the aim of highlighting that this method is desirable and mature to be spread and used in the Territory.

Through a blind analysis by some hospital Radiologists, in fact, it is shown that the examinations performed at the patient's home are, practically, superimposable to those performed in an outpatient setting.

## INTRODUCTION

The National Recovery and Resilience Plan (NRP) is a plan approved in 2021 to relaunch the economy after the COVID-19 pandemic and provides for an investment and reform package divided into six Missions, including Health. The recent pandemic has clearly demonstrated how the Hospital/Territory axis has not been able to withstand the impact of an event such as the COVID pandemic. With a view to an overall improvement of the system, the PNRR gives us the opportunity to intervene by completely redesigning the territorial health and the goal is to compensate for the current territorial care inequalities and bridge the distance between the traditional places of care and the daily life of the patient, strengthening the health and social health network in the territory with better primary care services.

In this context, Home Radiology, a branch of radiology, is inserted, which deals with all procedures aimed at performing traditional radiographic examinations at the home of the non-ambulatory and /

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To validate the activity of Home Radiology, in this experimental study, radiographic examinations performed at home were compared with radiographic examinations performed in the hospital with the aim of highlighting that this method is desirable and mature to be spread and used in the Territory.

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## MATERIALS AND METHODS

In the study, patients were selected who had already undergone radiological investigation in hospital but who required further radiological investigation at home for checks.

10 patients were recruited;

- n. 4 (males) subjected to radiological investigation both at home and at the hospital.

- n. 6 (females) subjected to radiological investigation both at home and at the hospital.

The overall mean age of patients is 84aa. The mean age of female patients is 89aa. The mean age of male patients is 72aa. Patients were exclusively subjected to:

- radiological examinations of the chest,
- radiological examinations of the pelvis,
- radiological examinations of the hip.

The number of radiograms performed was 20:

- 10 chest radiograms
- 10 radiograms between pelvis or hip.

The patients were not recruited specifically for the study, but are those who turned to the TSRM Volunteers Association of Andria to perform the different x-rays and therefore it was not necessary to collect consent.

For home radiology activities, two TSRMs will be identified:

A TSRM operates on the patient; the second TSRM operates on the RX portable device.

Both operators, as per procedure, wear all PPE and the leaded coat:

- TSRM 1 wears a pair of gloves
- TSRM 2 wears a pair of gloves

In the patient's room, the TSRM 1 places the patient and the X-ray tape, for acquisition

In the patient's room, TSRM 2:

- Position the RX handheld device for capture Instructs the patient to stand still and maintain apnea (if required)

After taking the exam, TSRM 1:

- Retrieve the X-ray tape and fix the patient The TSRM 1 and TSRM 2 proceed to sanitize the portable device RX and the X-ray cassette as per procedure.

### Image Analysis

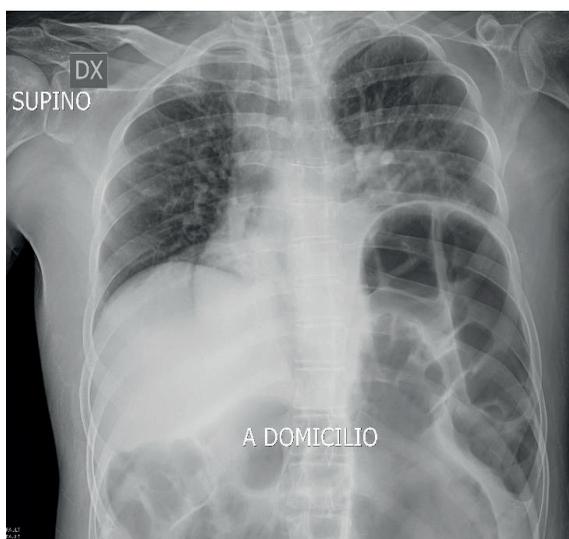
Based on the examinations carried out, an analysis of the images is performed to verify that the criteria of correctness provided are respected in both radiographs, going to validate the method:



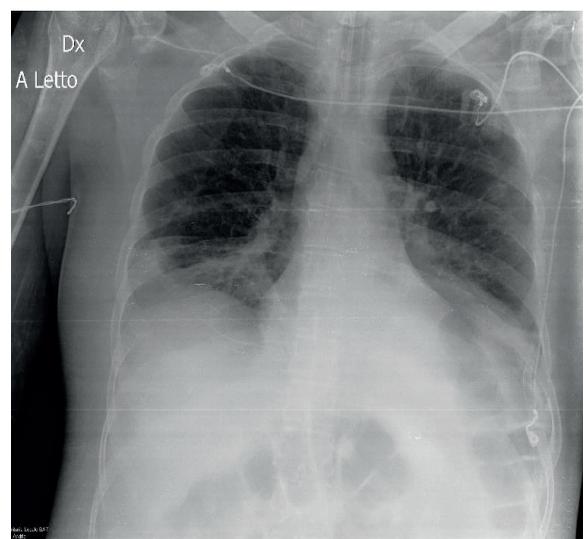
**Fig. 1a** - AP pelvis performed in hospital.



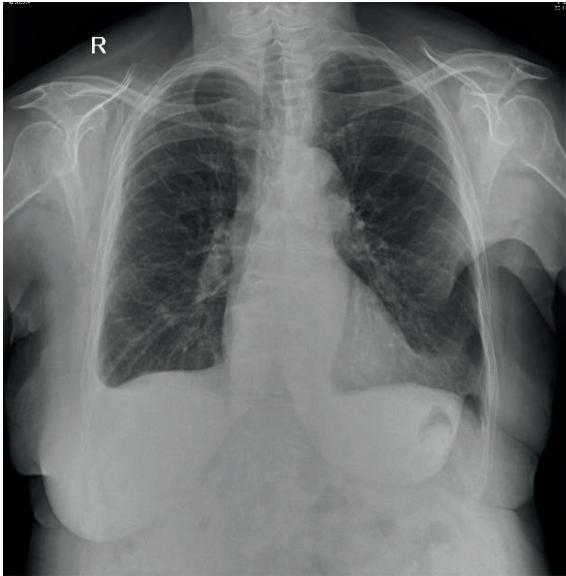
**Fig. 1b** - AP HIP performed at home.



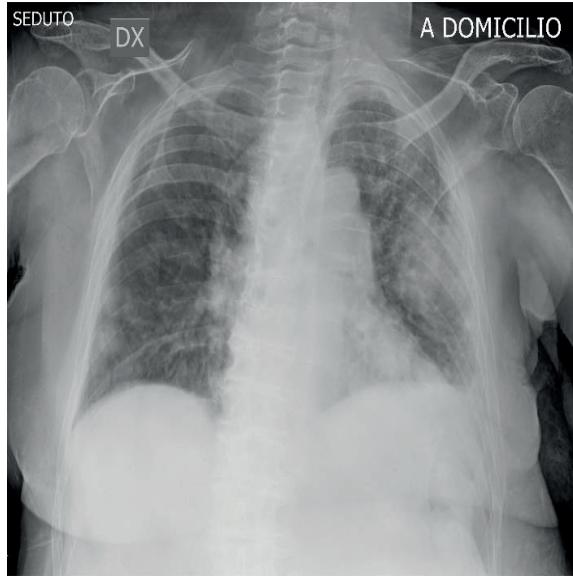
**Fig. 2a** - AP chest performed in hospital.



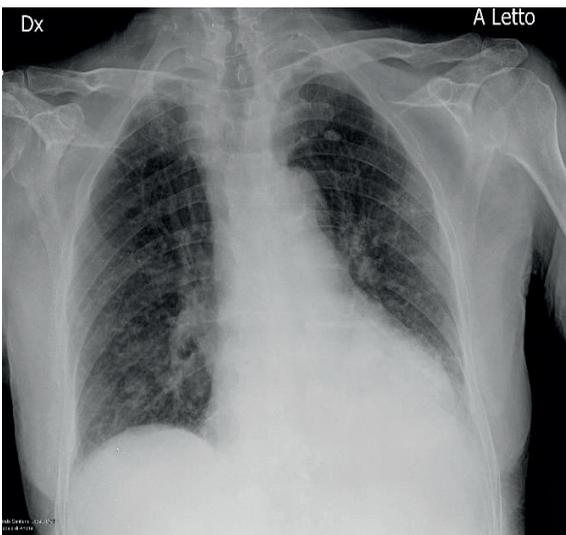
**Fig. 2b** - AP Chest Performed At Home.



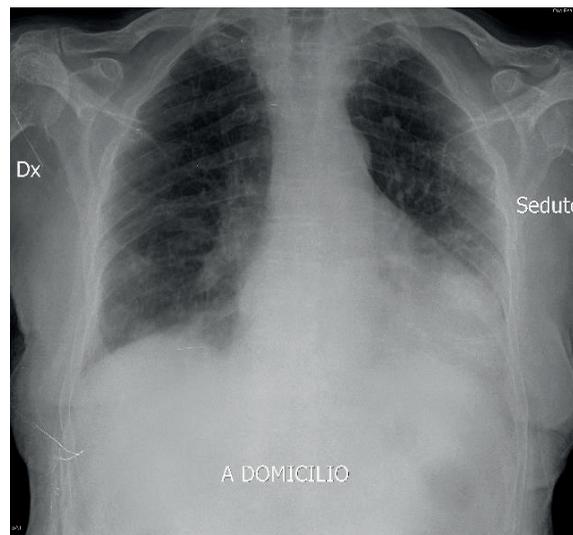
**Fig. 3a** - PA chest performed in hospital.



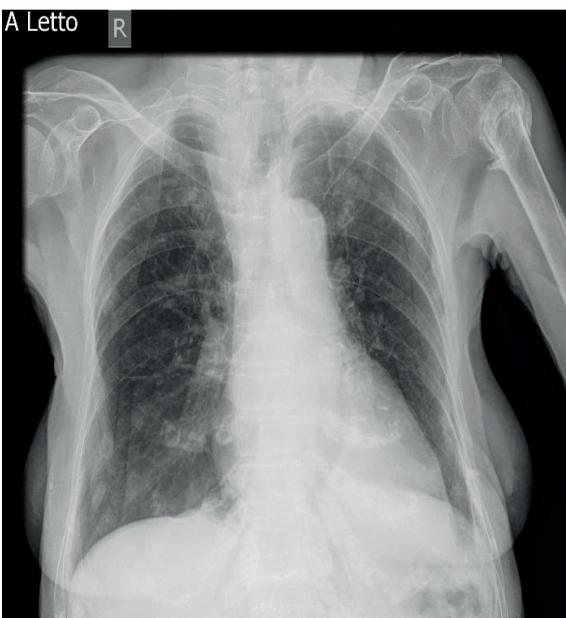
**Fig. 3b** - AP chest performed at home.



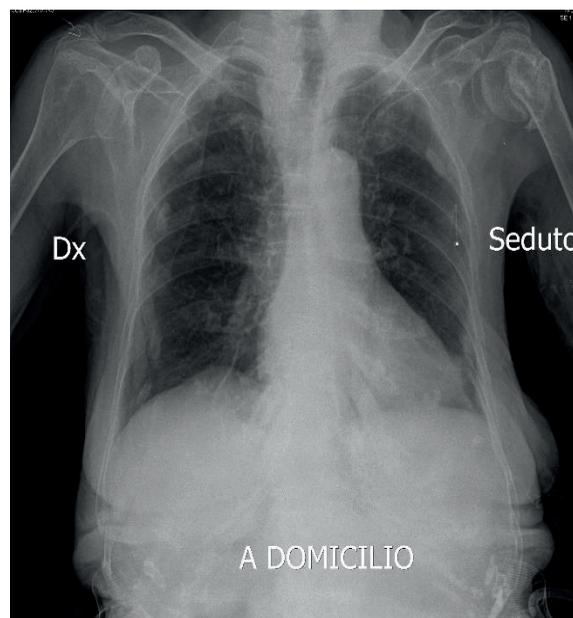
**Fig 4a** - AP chest performed in hospital.



**Fig 4b** - AP chest performed at home.



**Fig. 5a** - AP chest performed in hospital.



**Fig. 5b** - AP chest performed at home.



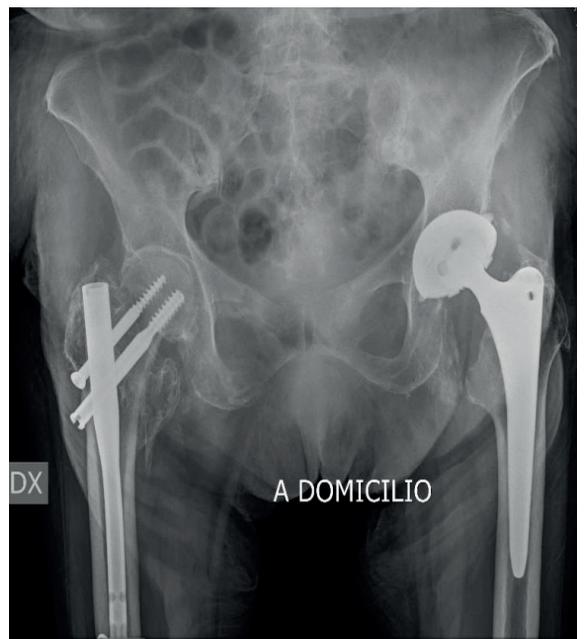
**Fig. 6a** - AP pelvis performed in hospital.



**Fig. 6b** - AP pelvis performed at home.



**Fig. 7a** - AP hip performed in hospital.



**Fig. 7b** - AP pelvis performed at home.



**Fig. 8a** - AP hip performed in hospital.



**Fig. 8b** - AP hip performed at home.

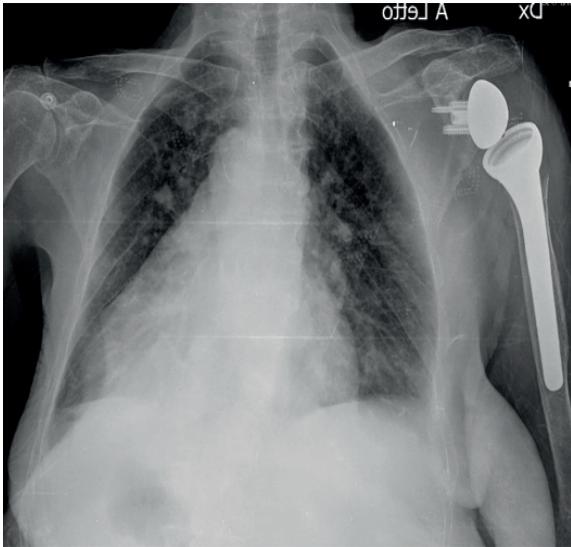


Fig. 9b - AP chest performed at home.



Fig. 10a - AP HIP performed in hospital.

**Qualitative Analysis**

It is necessary to verify the quality of the radiographic image of the subject studied at home by comparing it with a radiogram of the same district made to the same subject in the hospital with the same radiographic technique.

For this purpose, 3 Radiologists of different experience have been recruited:

- Radiologist (1) M.L. with 8 years of experience;
- Radiologist (2) F.Q. with 17 years of experience;
- Radiologist (3) P.M. with 22 years of experience.

Blinded, they analyzed and evaluated the images by answering a questionnaire. The evaluation was carried out, through a vote of “LITTLE-ENOUGH-MUCH”, according to the questions contained in the following table (Table 1).



Fig. 10b - AP anca eseguita a domicilio

	DOCTOR 1 M.L.			DOCTOR 2 F.Q.			DOCTOR 3 P.M.		
	LITTLE	ENOUGH	MUCH	LITTLE	ENOUGH	MUCH	LITTLE	ENOUGH	MUCH
Is the home X-ray traceable?									
Are the criteria of correctness met in home radiography?									
Is the image quality comparable to that of the hospital?									
Are the two x-rays performed overlapping?									

Tab. 1 - Questionnaire submitted to Medical Radiologists, completed for each sample.

From the questionnaire, submitted to the 3 radiological doctors, the following results are obtained:

	DOCTOR 1 M.L.			DOCTOR 2 F.Q.			DOCTOR 3 P.M.		
	<i>LITTLE</i>	<i>ENOUGH</i>	<i>MUCH</i>	<i>LITTLE</i>	<i>ENOUGH</i>	<i>MUCH</i>	<i>LITTLE</i>	<i>ENOUGH</i>	<i>MUCH</i>
Is the home X-ray traceable?									
Figure 1a Figure 1b			✓			✓			✓
Figure 2a Figure 2b			✓			✓			✓
Figure 3a Figure 3b			✓			✓			✓
Figure 4a Figure 4b			✓			✓			✓
Figure 5a Figure 5b			✓			✓			✓
Figure 6a Figure 6b		✓			✓			✓	
Figure 7a Figure 7b			✓			✓		✓	
Figure 8a Figure 8b			✓			✓			✓
Figure 9a Figure 9b			✓			✓			✓
Figure 10a Figure 10b			✓		✓			✓	

Tab. 2

	DOCTOR 1 M.L.			DOCTOR 2 F.Q.			DOCTOR 3 P.M.		
	<i>LITTLE</i>	<i>ENOUGH</i>	<i>MUCH</i>	<i>LITTLE</i>	<i>ENOUGH</i>	<i>MUCH</i>	<i>LITTLE</i>	<i>ENOUGH</i>	<i>MUCH</i>
Are the criteria of correctness met in home radiography?									
Figure 1a Figure 1b			✓			✓			✓
Figure 2a Figure 2b			✓			✓			✓
Figure 3a Figure 3b			✓			✓			✓
Figure 4a Figure 4b		✓				✓			✓
Figure 5a Figure 5b			✓			✓			✓
Figure 6a Figure 6b		✓			✓			✓	
Figure 7a Figure 7b			✓			✓		✓	
Figure 8a Figure 8b		✓			✓			✓	
Figure 9a Figure 9b			✓			✓			✓
Figure 10a Figure 10b			✓		✓			✓	

Tab. 3

	MEDICO 1 M.L.			MEDICO 2 F.Q.			MEDICO 3 P.M.		
	<i>POCO</i>	<i>ABBASTANZA</i>	<i>MOLTO</i>	<i>POCO</i>	<i>ABBASTANZA</i>	<i>MOLTO</i>	<i>POCO</i>	<i>ABBASTANZA</i>	<i>MOLTO</i>
Is the image quality comparable to that of the hospital?									
Figure 1a Figure 1b			✓			✓			✓
Figure 2a Figure 2b			✓			✓			✓
Figure 3a Figure 3b			✓			✓		✓	
Figure 4a Figure 4b		✓			✓			✓	
Figure 5a Figure 5b		✓			✓			✓	
Figure 6a Figure 6b		✓		✓			✓		
Figure 7a Figure 7b			✓			✓		✓	
Figure 8a Figure 8b		✓			✓			✓	
Figure 9a Figure 9b			✓			✓			✓
Figure 10a Figure 10b			✓	✓				✓	

Tab. 4

	DOCTOR 1 M.L.			DOCTOR 2 F.Q.			DOCTOR 3 P.M.		
	<i>LITTLE</i>	<i>ENOUGH</i>	<i>MUCH</i>	<i>LITTLE</i>	<i>ENOUGH</i>	<i>MUCH</i>	<i>LITTLE</i>	<i>ENOUGH</i>	<i>MUCH</i>
Are the two x-rays performed overlapping?									
Figure 1a Figure 1b		✓			✓			✓	
Figure 2a Figure 2b		✓			✓			✓	
Figure 3a Figure 3b			✓			✓	✓		
Figure 4a Figure 4b			✓	✓			✓		
Figure 5a Figure 5b			✓			✓			✓
Figure 6a Figure 6b		✓		✓			✓		
Figure 7a Figure 7b			✓			✓		✓	
Figure 8a Figure 8b		✓			✓			✓	
Figure 9a Figure 9b			✓			✓			✓
Figure 10a Figure 10b			✓		✓			✓	

Tab. 5

**DISCUSSION**

The TSRM Volunteers Association Andria is formed by TSRM employees of the NHS who volunteer in order to institutionalize Home Radiology and that also for the home of patients has adopted the same security measures that are adopted in the Hospital; therefore compliance with the basic rules of distance with the use of PPE (personal protective equipment) even at the patient’s home, in addition to the canonical ones of radiation protection. It aims to minimize the discomfort of elderly and disabled citizens who need radiological checks but who have difficulty reaching hospital or territorial care facilities. In addition, it aims to improve care, respond efficiently to patient needs and limit citizens’ inconvenience. The main objective is to ensure continuity of care between the different levels of care and in particular in the delicate border between hospital and territory.

In this experimental study, radiographic examinations performed at home were compared with radiographic examinations performed in some hospitals of the ASL BT, thanks to the help of the volunteer TSRM of Andria, with the aim of highlighting that this method is desirable and mature to be spread and used in the Territory.

Analyzing the iconographic results obtained from the study, we are going to verify the radiographic suitability in 10 patients of whom they performed both the radiographic examination at home and the radiographic examination performed in diagnostics at the Lorenzo Bonomo hospital in Andria in an emergency regime. Evidence of the clinical indication and the referring doctor, it was found that the image quality and the conditions of the patient at home, are in 80% of cases favorable, compared to an X-ray examination, performed in emergency at the hospital diagnostics. Since the patient, once stabilized and brought back to his home, it will be much easier both for the TSRM staff, but above all for the patient himself, avoiding continuous movements and home, is automatically reduced, also facilitating TSRM staff.

From the samples used and studied, we observe that: *Figure 1a* represents an AP projection of the pelvis performed at the Emergency Room of the Lorenzo

Bonomo Hospital in Andria where a correct symmetrical representation of the pelvis and the proximal epiphyses of the femurs is displayed and if the patient is able to intrarotate the feet by a few degrees, it is also possible to visualize the greater trochanter. The referring physician identifies a midcervical fracture of the left femur. *Figure 1b*, an AP projection of the left hip was performed where a correct visualization of the coxofemoral joint is guaranteed and thanks to the intra-rotation of the patient’s foot it is also possible to visualize the greater trochanter. The usefulness of the home radiology service in this particular patient is highlighted due to his age and the degree of fracture.

**RESULTS AND CONCLUSIONS**

From the x-rays, submitted to the questionnaire, relating to the first patient, the following results were obtained (Tab. 6).

Analyzing the results obtained, relating to each sample of our study, thanks to the availability and work of the Radiologists and the Volunteer TSRM of Andria, it was possible to highlight that the examinations performed at home are, practically, superimposable to those performed in the Hospital (in emergency), ensuring greater comfort for fragile patients, going to minimize patient movements and any complications due to travel, going to reduce the waiting lists on the territory in the hospital and to reduce the time and money required to transport, in the hospital, a non- ambulatory patient, sometimes very expensive. It has also been verified that both the examinations performed at home and in the hospital fall within the I Dose Class (according to Article 161 of Legislative Decree 101/2020), so the same patient receives the same dose, provided for that examination, regardless of where he performs it.

In conclusion, the rapid change in the population, with the numerical growth of elderly subjects, has greatly modified the functioning of the network of hospital and extra- hospital services. Therefore, the need arises to take care of many elderly subjects, suffering from chronic evolutionary diseases and often in multiple association where, important, the integration between new technologies and continuous assistance is impor-

	MEDICO 1 M.L.			MEDICO 2 F.Q.			MEDICO 3 P.M.		
	POCO	ABBASTANZA	MOLTO	POCO	ABBASTANZA	MOLTO	POCO	ABBASTANZA	MOLTO
Is the home X-ray traceable?			✓			✓			✓
Are the criteria of correctness met in home radiography?			✓			✓			✓
Is the image quality comparable to that of the hospital?			✓			✓			✓
Are the two x-rays performed overlapping?		✓			✓			✓	

Tab. 6 - Table for Figures 1a/1b

tant. In addition to a humanistic approach to the sick and frail patient, it is necessary to guarantee a clinical and organizational appropriateness that tends to prefer the aspects of quality of life to the simple treatment of diseases; Therefore, in the field of continuity of care, home hospitalization methods are considered a “bridge” between hospital and territory.

Nevertheless, this new business model must meet certain requirements of acceptability, effectiveness, efficiency, appropriateness and safety of interventions. Home radiology is the demonstration that technologies, exportable to the home, with very low economic and ecological impact can significantly improve the quality of life of patients, contributing to significantly reduce health costs. This activity has been faced for years on the territory by many health professionals; Today, they are joined by the medical radiology technician who must not miss the opportunity to demonstrate that he is ready to make his contribution to the construction of a new effective, efficient and safe model of healthcare. The Home Radiology unit allows to project an activity that seemed to be only achievable within hospital facilities and has allowed to overcome what are the problems of fragile subjects, with serious pathologies. The goal is to ensure integration between hospital and terri-

tory, extending the activity of Home Radiology on the territory by performing an extra-hospital path avoiding subjecting fragile patients to discomfort and further complications due to travel, risks of psycho-physical alterations and offering social, economic and relational advantages. Carrying out home examinations for this type of patient has considerable advantages in terms of both practical and human and social relationships such as:

- Avoid transporting the fragile patient with means and facilities that could be used for more important and serious cases
- Support family members, caregivers and inpatient care providers in the clinical management of the patient
- Reduce costs for patients, family members and inpatient facilities Reduce inconvenience for the fragile patient
- Reduce the risk of contagion in case of epidemic events
- Contribute to improving the living conditions of the family and the patient himself.

Therefore, Home Radiology has made it possible to bring Health to the territory by solving the main problems of social and health care related to the high presence of elderly people and non-self-sufficiency.

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