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Technical note

How to set up a mobile X-ray unit in the community - Implementation initiatives for patient-centred care

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ABSTRACT

Background: Mobile X-ray unit have previously been widely used within hospitals in general, predominately for imaging patients admitted to intensive care units or for patients who cannot tolerate a visit to the radiology department. It is now possible to have an X-ray examination outside the hospital in nursing homes or to bring the service to frail, vulnerable or disabled patients. A visit to the hospital can be a frightening experience for vulnerable patients living with dementia or other neurological disorder. It can potentially have a long-term impact on the patient's recovery or behaviour. This technical note aimed to provide insight into the planning and running of a mobile X-ray unit in a Danish setting.
Methods: This technical note draws on the lived experiences of radiographers operating and managing a mobile X-ray service, sharing experiences with the implementation process and the challenges and successes of a mobile X-ray unit.
Results and key findings: Successes include that frail patient, especially those with dementia, benefit from mobile X-ray examinations, as they can remain in familiar surroundings during an X-ray procedure. In general, patients experienced an increased quality of life and less need for sedation medication due to anxiety. Also, working within a mobile X-ray unit is meaningful work for radiographers. Challenges included increased physicality of work, the funding required for the mobile unit, planning a communication strategy to the referring general practitioners, and permission from authorities to perform mobile examinations.
Conclusion: We have successfully implemented a mobile radiography unit that provides a better service for vulnerable patients through learning from successes and challenges.
Implications for practice: The mobile radiography setup can benefit vulnerable patients and provide meaningful work for the radiographers. However, transportation of mobile radiography equipment outside the hospital includes many considerations and challenges.
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Introduction

Mobile X-ray units have always been widely used within hospitals, primarily for imaging patients admitted to intensive care units. Outside the hospital, mobile units in Denmark are typically used to offer examinations to homeless people, asylum seekers or nursing home residents.[1–8] For the elderly population living in nursing homes, a visit to the X-ray department can be a frightening experience that may lead to increased disorientation, delirium, or anxiety.[9] It can also impact the patients' behaviour as they may require extra care before, during and after the X-ray examination.[9–12] In 2015 the number of people diagnosed with dementia in Denmark was 65,000, and today around 90,000 people are living with dementia; a figure that continues to increase due to the ageing Danish population.[13]

Nursing home residents have a positive attitude towards mobile X-ray examinations. Previous work has shown it offers minimal disruption during daily activities in a familiar environment.[14,15] A trustful collaboration between the radiographer and healthcare staff provides for a safe and fast examination.[15] However, continuous cooperation between healthcare professionals is essential.[16] This collaboration requires other competencies for radiographers working in a mobile unit, such as communication, flexibility, and

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innovation.[17] Studies have shown that a mobile X-ray unit can be cost-effective, as a Norwegian study found a 30% cost reduction by implementing a mobile X-ray service.[18] Also, a Swedish study found that mobile X-ray had a lower cost per examination than hospital examinations.[19] However, a recent randomised controlled trial found no reduction in hospital admissions comparing mobile to hospital X-ray.[3] This technical note aims to provide insight into the planning and running of a mobile X-ray unit (see Table 1 and 2).

Method

Pilot study

A pilot was carried out for the mobile X-ray unit at Kolding Hospital from the 1st of January 2018 until ultimo December 2020. The mobile X-ray unit had one transportable digital radiography (DR) system. During the 2-year pilot period, three studies documented the project,[15,17,20] leading to a fully implemented mobile unit. The mobile unit examinations included both chest and skeleton examinations with a Sedecal Dragon SPLW 4.0 mobile X-ray system (La Ricamarie, France).

The mobile unit included five specially trained radiographers and on weekdays, one radiographer is assigned to the mobile unit. Once a call is received and verified, the radiographer leaves the X-ray department and drives the specially equipped van with an X-ray system to the nursing home. The radiographer must navigate parking; unload the mobile unit; communicate with the staff; find the patient and undertake the examination.

Funding, planning and authorisation

The pilot mobile X-ray unit was funded by the Region of Southern Denmark, including the van, X-ray equipment and two years of radiographer salary. Subsequently the department decided to continue the mobile service as an integrated part of the department services, but without external funding.

Authoring permission from the national authorities was a time-consuming process and was only possible because local radiation protection physicists understood the vision and purpose of the pilot. They helped address questions when nursing home staff raised concerns about the dangers of radiation and created a leaflet explaining the radiation levels and the radiographers' responsibility to ensure the radiation protection of all in the nursing homes. A communication strategy covered GPs, nursing homes, and hospital staff, including information meetings and social media advertisements. The information video can be seen using this link https://www.linkedin.com/feed/update/urn:li:activity:6948197124408786944/.[21]

Results

After the examination, images are sent electronically to the department. The report is made and sent to the referring general practitioner (GP). If the request was for an emergency, such as a fracture, the radiographer stays until a reporting radiographer has seen the images and determined whether it is fractured (Fig. 1).

In case of a fracture being in question, the reporting radiographer contacts an orthopaedic surgeon and a plan for surgery is made on whether the patient needs to come to the emergency room or if the nursing staff can handle the fracture (Fig. 2). The radiographer receives information within 15 min and can pass on the information to the nursing staff, patient, or relatives.

Table 2
Overview of considerations in the process.

What do you need to get started?
The permit from the national radiation protection board
Portable equipment and van for transportation
Portable Wi-Fi to transfer images to PACS
Workflow description (protocol) to enable speedy response
Creative and skilled radiographers
A smartphone for communication and road directory (GPS)
Radiation protection shielding
Communication strategy

Challenges

The most challenging aspect experienced during the pilot period was the DR equipment (Fig. 3). It was difficult to navigate through rooms in nursing homes due to the furniture. However, this did not affect the image quality.[20] A replacement of DR equipment took place in 2021.

A patient case study

An older woman with dementia was scared of the male radiographer and the equipment and reluctant to let him enter her room. The radiographer recognised a tea set from his own Grandmother's home. He started talking about the tea set, and slowly she began to relax and spoke about the times she had used the tea set with friends and family. Trust was established, and he was allowed into the room. The conversation progressed to a discussion of X-rays when X-ray was discovered and her memories of childhood X-rays. In this instance, the home environment provides social clues and a comforting environment for the patient. This unique patient interaction can be more challenging in a busy radiology department.

Discussion

This project started with the vision of providing a better service to vulnerable elderly patients in nursing homes. Planning is vital; in our case, it took about one year of planning. Today the mobile unit runs as an integrated part of our department. The collaboration with nursing homes, authorities and even local town councils has proved beneficial for patient safety. Every three months, our department sends an anonymous report on the number of examinations performed in each district. The nursing homes and healthcare professionals use these data for strategic planning for

Table 1
An overview of the advantages and disadvantages of the mobile X-ray unit.

Advantages	Disadvantages
Patients remain in their own home during the examination	Physical work environment
Meaningful work for radiographers	What happens when the van needs to be serviced?
More proximity in health – less hospital	Requires funding
Development for the radiographers involved	Communication plan to reach the referring GP
Increased quality of life	Permission from authorities

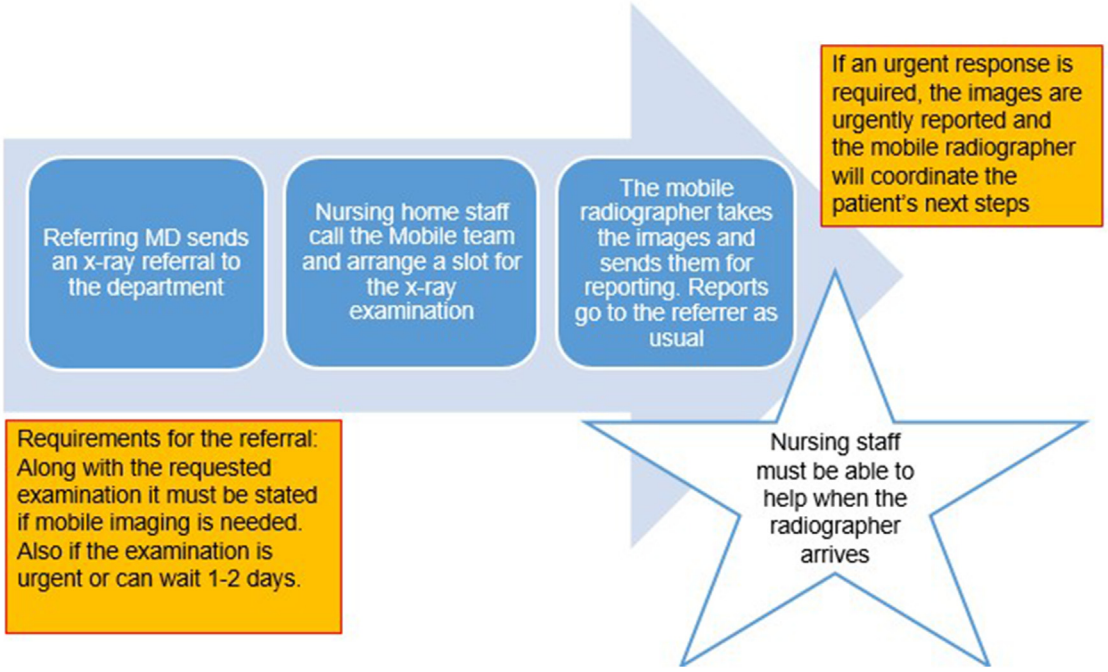


Figure 1. The mobile X-ray unit workflow.

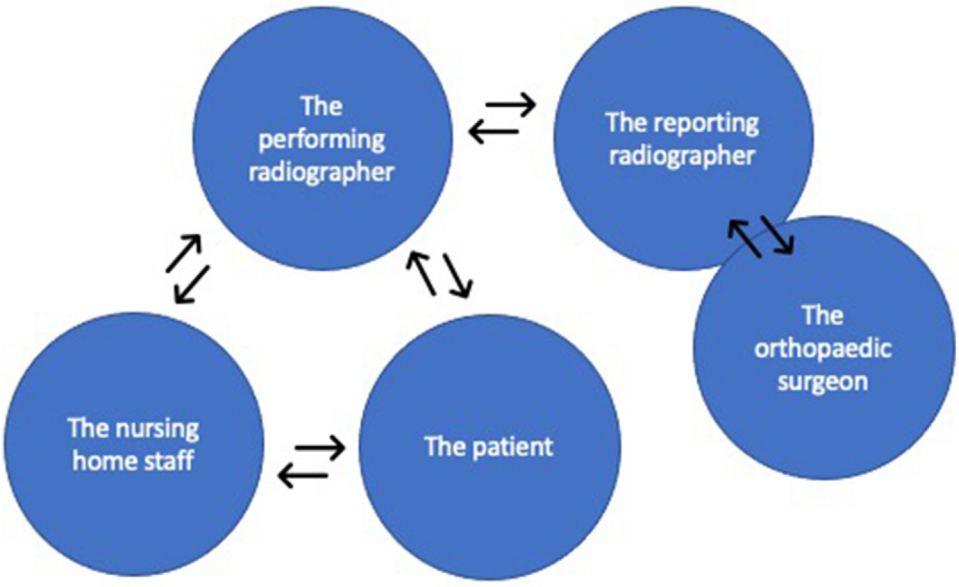


Figure 2. The workflow for patients needing treatment after imaging.

falls prevention. Thus, the mobile unit has a new role in patient safety beyond radiation protection. This finding is also confirmed by two reviews that found mobile X-ray units increases adequate treatment and care[22] and reduces burdensome transfers, waiting time.[1]

If these patients were transferred to the hospital, it is likely that they would also need blood samples or other tests. There will be increased waiting times and a higher chance that the comorbidities will result in an increased hospital stay. These are all costly processes and can be avoided if the patient can be examined at home until the diagnosis is confirmed. In addition, the cost of patient transportation via ambulance, nursing support in transit and additional medication are also costly. Pilot data from 50 patients demonstrated that pathology was present in 19% of the cases 50% of these needed hospital attention, and 50% did not. These data indicate that the mobile radiography service possibly prevented hospital visits for the 81% whose X-rays were normal and the 9.5% of patients with pathology assessed as not needing an admission. Further work on a larger scale is required to evaluate mobile radiography's clinical and economic benefits.



Figure 3. Radiographer Kathrin Wittenkamp at work. Notice the long "fork" anterior to the equipment that caused trouble navigating in nursing homes.

Future focus

The next steps are to examine whether the number of hospital admissions is reduced due to implementing the mobile X-ray unit and to conduct a cost-effectiveness analysis of the service.

Conclusion

Starting a mobile X-ray unit is an ongoing project that requires focus from management to succeed. It is complex, is an economic burden, and is very time-consuming. Still, it also has great development potential for radiography, benefits the patients and shows that radiology departments play a significant role in patient safety and public health.

Conflict of interest

The authors has no conflicts of interest to declare.

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