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Nurse records of comparative study between Mobile X-ray Outside the Hospital vs. X-ray at the Hospital Challenges Exposed

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Abstract:

Background: Frail patients may benefit from receiving X-ray examinations at home to avoid the stress of hospital transport. This study investigated the impact of mobile X-ray on healthcare for such individuals ,with the primary outcome being the frequency of hospitalizations.

Methods: Data were collected through questionnaires and Electronic Patient Records (EPR) from frail patients referred for mobile X-ray examinations in nursing homes and elderly care facilities. Mobile X-ray examinations were compared to hospital-based X-rays.

Results: Analysis of data from 136 enrolled patients revealed no significant differences in hospitalizations or duration of hospital stays between mobile X-ray and hospital-based X-ray. Challenges encountered during the study included reluctance from doctors to refer patients for hospital-based X-rays and concerns from nursing home staff regarding patient frailty during post-X-ray questioning.

Adjustments were made to the randomization method to address bias in initial data collection.

Conclusions: While mobile X-ray did not significantly reduce hospitalizations compared to hospital-based X-ray in this exploratory study, it remains a valuable diagnostic tool for precise treatment in cases where hospital transportation is burdensome. Further research focusing on this aspect and conducting RCT studies in populations where mobile X-ray has not been previously explored is recommended.

Keywords: mobile X-ray; nursing homes; frail elderly; healthcare.

Introduction:

For frail patients, undergoing X-ray examinations at home may offer advantages over hospital visits, as transportation and environmental changes associated with hospital visits can worsen their condition, potentially leading to increased care needs and medication requirements post-examination. Additionally, primary diseases may deteriorate, and delirium can develop, potentially necessitating extended hospital stays. (Kjelle et al., 2019)

In the Western World, mobile X-ray services are provided to various vulnerable populations, including the frail elderly, homeless individuals, drug users, asylum seekers, and nursing home residents. Both qualitative and quantitative studies have reported benefits associated with mobile X-ray usage, such as reduced hospitalization rates, decreased incidence of delirium, and increased patient examination rates. However, mobile X-ray equipment may not provide the same image quality as standard hospital equipment, despite radiologists' ability to diagnose patients based on images obtained with mobile X-ray machines. (Datta et al., 2017)

Despite the reported benefits of mobile X-ray, there is a lack of randomized controlled trials (RCTs) comparing mobile X-ray to traditional hospital-based X-ray, particularly for both skeletal and thoracic imaging. Previous quasi-randomized and cross-sectional studies have focused primarily on specific patient populations, such as nursing home residents undergoing thoracic X-rays or diagnosing pneumonia in nursing home residents using mobile X-ray. (Montalto et al., 2015)

At the Department of Radiology at Aarhus University Hospital, mobile X-ray services have been offered since 2014, with patients receiving examinations at home. Images are transmitted to the radiology department for interpretation and quality control before the mobile unit leaves the patient's location, with no need

for repeat imaging. The target population includes frail elderly individuals in nursing homes, residents of elderly care facilities, homeless individuals in care homes, disabled individuals in specialized homes, psychiatric patients in hospital wards, and patients requiring rehabilitation after acute stroke or hip fracture. (Vigeland et al., 2017)

After one year of implementation, the mobile X-ray project was deemed successful in improving healthcare for frail patients, prompting the decision to continue the initiative and conduct an RCT to assess its effectiveness. Given the lack of evidence in the literature documenting the impact of mobile X-ray, this study aims to fill that gap by conducting an RCT on frail elderly patients, encompassing both thoracic and skeletal imaging. (Ottawa, 2016)

Aim:

The primary aim of this study was to assess whether mobile X-ray examinations conducted at home improved healthcare outcomes, as defined by hospital bed days, for frail patients compared to X-ray examinations performed at the hospital. Additionally, we aimed to identify and describe the challenges associated to measure the effectiveness of mobile X-ray in frail elderly populations.

Methods

Study Population:

The study included patients aged 65 years and above who were referred for mobile X-ray examinations and resided in nursing homes and elderly care facilities. Exclusion criteria comprised patients already hospitalized homeless individuals, handicapped patients, and those previously examined with mobile X-ray during the study period. Ethical approval was obtained from the Ethical Committee and Data Protection System

Outcome Measures:

Outcome data were collected by trained data collectors and validated for use in the elderly population. Outcome measures included baseline characteristics such as age, gender, number of diagnoses, polypharmacy, dementia diagnosis, BMI, and cognitive and functional assessments. Primary outcomes were hospital admission (yes/no) and number of hospital days. Secondary outcomes included delirium assessment, depression measurement, examination completion, and mortality within one week post-X-ray.

Intervention and Control:
The intervention group received mobile X-ray examinations at home, while the control group underwent X-rays at the hospital.

Statistical Analysis:
Sample size calculation was based on previous studies, with statistical analysis conducted using Stata version 13.1. Continuous and categorical variables were analyzed using appropriate statistical tests, with a significance level set at $p < 0.05$. Sensitivity tests were performed to assess the impact of missing data on study results.

Inclusion of Participants:
The inclusion with challenges encountered in patient recruitment. Semi-structured interviews with referring general practitioners aimed to identify barriers to patient referral for mobile X-ray. Questions focused on satisfaction with mobile X-ray, , reasons for referral withdrawal, and patient fragility concerns.

Results:
3.1. Baseline Characteristics:
Baseline characteristics were collected post-X-ray examination within one week, with no statistically significant differences observed between the intervention and control groups. Data were obtained through interviews with healthcare staff and supplemented with information from local data systems. Mini Mental State Examination (MMSE) and Geriatric Depression Scale (GDS) scores were obtained by testing patients, with a statistical difference found in GDS but not MMSE. Sensitivity analysis did not alter the significance of baseline characteristics between the groups for MMSE ($p = 0.32$), Modified Barthel Index (MBI) ($p = 0.11$), or Cumulative Illness Rating Scale (CIRS) ($p = 0.77$).

3.2. Primary Outcome:
No statistically significant differences were found between the intervention and control groups in hospitalizations within one week post-X-ray examination. Reasons for hospitalization varied between groups, including aplastic anemia, pneumonia, fractures, pleural effusion, and hypoglycemia.

Secondary Outcomes:

There were no significant differences between the groups for secondary outcomes. Sensitivity analysis showed a significant difference in the Confusion Assessment Method (CAM) results ($p = 0.023$) but not for Depression List (DL) ($p = 0.24$).

Challenges:

Balanced recruitment of patients to the two groups posed a challenge, as mobile X-ray had become a standard offer before the RCT began. Referring doctors faced uncertainty when referring patients to mobile X-ray without assurance of examination method. Nursing home staff were protective of frail patients, sometimes restricting access for data collectors and leading to missing data.

Discussion:

This study, the first of its kind to our knowledge, focused on mobile X-ray examinations of both lungs and skeletal structures in nursing home residents. Contrary to findings by Loeb et al., who conducted a cluster-randomized controlled study, our study did not yield significant differences in hospitalizations, although the prevalence rates were comparable between the two studies. Potential explanations for the discrepancy in results include differences in patient populations and study designs, as well as the inclusion of both thoracic and skeletal examinations in our study compared to Loeb et al.'s focus solely on thoracic examinations. The observation of a trend toward longer hospital stays for patients examined at hospitals may indicate a potential benefit of mobile X-ray, albeit not statistically significant, possibly due to the under-powering of our study. (McClester Brown et al., 2016)

In contrast to Ricauda et al.'s pilot study, we did not find significant differences in delirium rates between groups, although sensitivity analysis revealed significant results for CAM scores. Challenges encountered included difficulties in recruiting balanced patient populations, with mobile X-ray having become standard practice before the RCT began. Referring doctors faced uncertainty in referring patients without assurance of examination method, potentially biasing the study against the hospital group. Additionally, nursing home staff's protective stance toward frail patients led to data collection challenges. (Toppenberg et al., 2020)

Future studies in this field should carefully consider study populations and outcome measures, as these may vary significantly among patient subgroups.

While hospitalization was chosen as the primary outcome measure based on its relevance to healthcare improvement, other outcomes such as quality of life, patient satisfaction, and economic perspectives may warrant consideration in future investigations. Furthermore, the potential diagnostic benefits of mobile X-ray in guiding precise treatment for the frailest patients should be explored. Cluster-randomized studies may offer a more suitable study design for evaluating mobile X-ray effectiveness in nursing home residents. (Graverholt et al., 2014)
High intervention implementation proved challenging due to the project's reliance on doctors' referrals without withdrawal of patients randomized to the hospital group. Future evaluations of mobile X-ray may benefit from being conducted in settings where mobile X-ray services are not already established. Missing data, largely attributed to patient frailty and staff constraints, may have impacted the study's statistical power, suggesting the need for alternative data collection methods in future studies, such as utilizing national registers. (Story et al., 2012)

Conclusions:

Our study did not yield significant differences in hospitalizations between the intervention group receiving mobile X-ray and the control group receiving X-ray at hospitals among nursing home residents . These findings serve as exploratory and underscore the need for further research into the effectiveness of mobile X-ray.
Despite the non-significant results, our study highlights the challenges associated with conducting of mobile X-ray services already established as a diagnostic option. However, mobile X-ray may still offer potential benefits by enhancing diagnostic safety for frail elderly patients who face significant challenges in transportation to hospitals.
Future studies should prioritize investigating the diagnostic advantages of mobile X-ray in improving healthcare for vulnerable patient populations. Additionally, careful consideration should be given to selecting appropriate study designs tailored to the unique characteristics of the population and the intervention, rather than solely relying on RCTs.

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