Author Contributions: All authors had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Searles. *Acquisition of data:* Shapiro. *Analysis and interpretation of data:* Edwards and Searles. *Drafting of the manuscript:* Edwards. *Critical revision of the manuscript for important intellectual content:* Searles and Shapiro. *Statistical analysis:* Edwards.
Financial Disclosure: None reported.

1. Warner M, Chen LH, Makuc DM. *Increase in Fatal Poisonings Involving Opioid Analgesics in the United States, 1999-2006*. Hyattsville, MD: National Center for Health Statistics; 2009. NCHS data brief, No. 22.
2. 18 V.S.A. §5205. Death certificate when no attending physician; autopsy.
3. Bohnert ASB, Valenstein M, Bair MJ, et al. Association between opioid prescribing patterns and opioid overdose-related deaths. *JAMA*. 2011;305(13):1315-1321.
4. Okie S. A flood of opioids, a rising tide of deaths. *N Engl J Med*. 2010;363(21):1981-1985.
5. Paulozzi LJ, Budnitz DS, Xi Y. Increasing deaths from opioid analgesics in the United States. *Pharmacoepidemiol Drug Saf*. 2006;15(9):618-627.
6. The White House Office of National Drug Control Policy. Epidemic: Responding To America's Prescription Drug Abuse Crisis. http://www.whitehousedrugpolicy.gov/publications/pdf/rx_abuse_plan.pdf. Accessed on May 27, 2011.

ONLINE FIRST | LESS IS MORE

The RAD-HOME Project: A Pilot Study of Home Delivery of Radiology Services

For decades, acute medical care has been delivered in a hospital. However, among frail elderly patients, hospitalization often results in delirium, nosocomial infections, pressure sores, and falls.[1] Appropriate home care has been shown to decrease hospitalization and nursing home use without compromising medical outcomes. In addition, providing traditional hospital-based care in the familiar surroundings of a patient's home might have the advantage of reducing the incidence of iatrogenic illness.[2]

See also page 1646

The delivery of medical services at home has been greatly facilitated by recent advances in technology and communications. In this randomized controlled pilot study, we explored the quality of imaging and clinical outcomes of using mobile, light-weight x-ray equipment to provide radiologic examinations to frail elderly patients at home.

Methods. We conducted a randomized controlled trial among patients in the Hospital at Home Service (HHS) of San Giovanni Battista Hospital of Torino, Italy.[3,4] Eligible participants were immobilized or chair bound, acutely ill, at intermediate or high risk of delirium according to the criteria of Inouye,[5] and in need of a radiological examination of the chest, pelvis, hips, joints, upper or lower limbs, hands, or feet. Patients were excluded if they had delirium according to the Confusion Assessment Method,[6] were in need of urgent examination (within 24 hours), or needed x-ray examinations not suitable at home. The study protocol was approved by the ethics committee of HHS, and all participants provided informed consent.

At baseline, all patients underwent assessment for eligibility, demographics, health status, depression, mental status, and comorbidities and an evaluation for delirium using the Confusion Assessment Method. Evaluation for delirium was repeated after the radiological examination. Whenever an episode of delirium occurred, the Delirium Rating Scale was completed. Patient satisfaction with home radiography was evaluated after the radiological examination.

Participants were randomly assigned to have radiological imaging performed at home or to have the imaging performed in the hospital. Outcomes were the feasibility and quality of radiological imaging at home, the incidence of delirium after the x-ray examination, and patient satisfaction.

Radiological examinations at home were performed by qualified radiology technicians using a light-weight, portable, high-frequency x-ray tube, improved cassettes (with imaging plate inside), and a mobile radiological station (Computed Radiography POC 260; Carestream Health, Rochester, New York) with remote visualization and real-time processing of acquired images. The equipment, transported in a small van, was in conformity with all applicable laws and the radiation safety standards of the relevant national and international organizations. The operators position themselves and the equipment to prevent anyone, except the patient, from entering the controlled area during x-ray exposure. If it is necessary to stand within the controlled area, the operators wear protective clothing.

Using the Picture Archive and Communication System, the radiology technicians directly transmitted the images acquired at home via wireless broadband Internet to the radiologists in the hospital who read radiographs in real time. Radiologists who read the examinations were blinded to the origin of the studies.

Evaluation of the quality of the images was conducted on chest x-rays of patients who performed this examination in the emergency department and repeated the radiography at home as a control.

The image quality was independently assessed by a group of 7 fully qualified clinical radiologists blinded to the origin of the radiographs. Radiologists used the European Guidelines on Quality criteria, modified for supine radiographs, to intraindividually compare the quality of chest images.[7] The following criteria were rated: symmetrical reproduction of the thorax; reproduction of the whole rib cage above the diaphragm; visually sharp reproduction of vascular pattern in the whole lung, trachea and proximal bronchi, borders of the heart and aorta, diaphragm, and lateral costophrenic angles; visualization of retrocardiac lung, mediastinum, and spine through the heart shadow; and small round details in the whole lung, including the retrocardiac area.

Results. Of the 463 patients admitted to the HHS between June 2008 and June 2009, 123 were eligible and 69 (55%) were enrolled and randomly assigned to radiography performed at home (n=34) or in the hospital (n=35).

At baseline, the 2 study groups were similar in all sociodemographic and clinical characteristics (**Table**). The mean age of the participants was 78 years and 45% were male. Most radiographs were performed for suspected ex-

Table. Baseline Characteristics of the Study Population[a]

Characteristic	Home Radiography Group (n=34)	Hospital Radiography Group (n=35)	*P* Value
Age, y	77.4 (16.4)	80.1 (8.2)	.39
Male sex, No. (%)	15 (44.1)	16 (45.7)	.89
Married, No. (%)	22 (64.7)	18 (51.4)	.38
Family support at home, No. (%)	34 (100)	35 (100)	.86
ADL	3.7 (2.4)	2.8 (2.3)	.11
IADL	5.0 (4.7)	7.0 (4.3)	.07
MMSE	21.6 (5.9)	23.5 (5.9)	.18
GDS	8.0 (7.8)	8.9 (9.1)	.67
CIRS			
Comorbidity index	2.2 (1.4)	2.2 (1.5)	.92
Severity index	1.5 (0.2)	1.6 (0.3)	.26
NRS	1.6 (1.5)	1.3 (1.5)	.35

Abbreviations: ADL, activities of daily living (0=no functions lost; 6=all functions lost); CIRS, Cumulative Illness Rating Scale: Comorbidity Index (0=absence of comorbidity; 13=highest comorbidity), severity index (1=lowest severity; 5=highest severity); GDS, Geriatric Depression Scale (0=absence of depression; 30=severe depression); IADL, instrumental activities of daily living (0=complete inability to perform daily activities; 14=all abilities preserved); MMSE, Mini-Mental State Examination (0=completely cognitively impaired; 30 not cognitively impaired); NRS, Numerical Rating Scale (0=none; 10=worst possible pain).

[a]Values are given as mean (SD) unless otherwise specified.

acerbation of congestive heart failure, exacerbation of chronic obstructive pulmonary disease, or pneumonia, and there were no differences in indication for radiography between the home and hospital radiography groups. In both groups, radiographs confirmed the clinical suspicion in approximately 70% of cases.

After radiological examination, an acute confusional state requiring treatment occurred in 17% of patients in the hospital radiography group, whereas no patient in the home radiography group developed delirium. The onset of delirium (100 % of patients were hyperactive) occurred within few hours of hospital radiological examination, and the mean (SD) duration of the episode was 1.2 (4.2) days. The mean (SD) score of the Delirium Rating Scale was 0.79 (3.6). Satisfaction with home radiography was very good or excellent for 94% of patients.

There were no significant differences in the quality of chest radiographies performed at home and those performed in hospital.

Comment. Among frail elderly patients, radiographs performed at home were of similar quality to those performed after admission to the hospital, and resulted in a significantly lower incidence of delirium. Almost all patients were highly satisfied undergoing imaging studies at home. Modern portable x-ray units are light enough to be easily transported and used in the home and may spare frail patients the trauma of transportation and unfamiliar surroundings, as well as other hospital-associated adverse effects.[8,9]

Our sample size was small and the findings may not be generalizable, given that the study was conducted at only 1 center and by an operationally mature hospital-at-home unit. Nevertheless, this is a pilot trial suggests that "health care is going home."[10]

Nicoletta Aimonino Ricauda, MD
Vittoria Tibaldi, MD, PhD
Paola Bertone, MD
Eleonora Quagliotti, MD
Alessandra Tizzani, MD
Mauro Zanocchi, MD
Giovanni Carlo Isaia, MD
Marco Grosso, RT
Teresa Cammarota, MD
Ottavio Davini, MD

Published Online: August 8, 2011. doi:10.1001/archinternmed.2011.336

Author Affiliations: Department of Medical and Surgical Disciplines–Geriatric Section, University of Torino (Drs Aimonino Ricauda, Tibaldi, Bertone, Quagliotti, Tizzani, Zanocchi, and Isaia), Radiology 2 (Dr Davini and Mr Grosso) and Radiology 5 (Dr Cammarota), San Giovanni Battista Hospital, Torino, Italy.
Correspondence: Dr Tibaldi, Department of Medical and Surgical Disciplines–Geriatric Section, San Giovanni Battista Hospital, Corso Bramante 88/90, 10126 Torino, Italy (tibaldi.vittoria@libero.it).

Author Contributions: Dr Tibaldi had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Aimonino Ricauda, Tibaldi, Isaia, Cammarota, and Davini. *Acquisition of data:* Tibaldi, Bertone, Quagliotti, Tizzani, and Grosso. *Analysis and interpretation of data:* Aimonino Ricauda, Tibaldi, and Zanocchi. *Drafting of the manuscript:* Aimonino Ricauda, Tibaldi, Bertone, Quagliotti, Tizzani, and Zanocchi. *Critical revision of the manuscript for important intellectual content:* Aimonino Ricauda, Tibaldi, Isaia, Grosso, Cammarota, and Davini. *Statistical analysis:* Tibaldi, Bertone, Quagliotti, Tizzani, and Zanocchi. *Study supervision:* Aimonino Ricauda, Isaia, Grosso, Cammarota, and Davini.
Financial Disclosure: None reported.
Additional Contributions: We thank Daniele Calò (nurse coordinator), Piergiorgio Savio, and all the Hospital at Home Service staff of San Giovanni Battista Hospital of Torino and Davide Minniti, Alessandro Beux, and the entire staff of radiology technicians and radiologists who helped us in the realization of the project.
Trial Registration: clinicaltrials.gov Identifier: NCT01098916

1. Leff B. Defining and disseminating the hospital-at-home model. *CMAJ*. 2009; 180(2):156-157.
2. Shepperd S, Doll H, Angus RM, et al. Avoiding hospital admission through provision of hospital care at home: a systematic review and meta-analysis of individual patient data. *CMAJ*. 2009;180(2):175-182.
3. Aimonino Ricauda N, Tibaldi V, Leff B, et al. Substitutive "hospital at home" versus inpatient care for elderly patients with exacerbations of chronic obstructive pulmonary disease: a prospective randomized, controlled trial. *J Am Geriatr Soc*. 2008;56(3):493-500.
4. Tibaldi V, Isaia G, Scarafiotti C, et al. Hospital at home for elderly patients with acute decompensation of chronic heart failure: a prospective randomized controlled trial. *Arch Intern Med*. 2009;169(17):1569-1575.
5. Inouye SK, Viscoli CM, Horwitz RI, Hurst LD, Tinetti ME. A predictive model for delirium in hospitalized elderly medical patients based on admission characteristics. *Ann Intern Med*. 1993;119(6):474-481.

6. Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. *Ann Intern Med.* 1990;113(12):941-948.
7. Szucs-Farkas Z, Vock P. Image quality of supine chest radiographs: intra-individual comparison of computed radiography and low-dose linear-slit digital radiography. *Eur Radiol.* 2009;19(9):2156-2162.
8. Laerum F, Amdal T, Kirkevold M, et al. Moving equipment, not patients: mobile, net-based digital radiography to nursing home patients. *Int Congr Ser.* May 2005;1281:922-925.
9. Sawyer RH, Patel U, Horrocks AW. Domiciliary radiography: an important service? *Clin Radiol.* 1995;50(1):51-55.
10. Landers SH. Why health care is going home. *N Engl J Med.* 2010;363(18):1690-1691.

Contribution of Common Medications to Lower Urinary Tract Symptoms in Men

While benign prostatic hyperplasia (BPH) is the most common cause, the etiology of lower urinary tract symptoms (LUTS) is multifactorial. Clinical guidelines for BPH suggest evaluating other potential sources of LUTS (eg, concomitant medication use) before initiating pharmacotherapy or surgical intervention.[1]

Through effects on detrusor muscle and urinary sphincter function, several categories of prescription drugs can worsen LUTS,[2,3] including antidepressants, antihistamines, bronchodilators, anticholinergics, and sympathomimetics.[4] By increasing urine volume, diuretics are also associated with LUTS.[5,6] Because their prevalence of use rises with patient age, prescription drugs may contribute to the age-related increase in LUTS.[7,8]

Most previous research has focused on LUTS overall, without accounting for heterogeneity in etiology. If a significant proportion of LUTS can be attributed to medication use, the observed association between a suspected risk factor and LUTS could be attenuated. Thus, it is important to determine the magnitude of the association between medications and LUTS, and the degree to which LUTS may be attributed to these medications. To this end, this study assesses the cross-sectional association between current use of selected common medications and LUTS among men enrolled in the California Men's Health Study (CMHS).

Methods. A detailed description of CMHS has been previously published.[9] Briefly, with institutional review board approval, men aged 45 to 69 years were recruited from the Kaiser Permanente California Medical Care Program (southern and northern regions). Through a 2-stage process, 84 170 participants completed questionnaires and were eligible for study inclusion using the baseline survey data and linked electronic health records between 2002 and 2003.

Men with surgery for enlarged prostate (n = 1601), prostatitis (n = 5547), or prostate cancer (n = 5487) were excluded. Other exclusion criteria included musculoskeletal conditions (n = 10 668), neurologic disorders (n = 2208), and cancers including bladder and colon (n = 1238). For the 63 579 remaining subjects, pharmacy records were assessed to determine prescription drug dispensation for antidepressants, antihistamines, bronchodilators, nonurinary anticholinergics, sympathomimetics, and diuretics during the baseline survey period with at least 1 prescription filled.

Severity of LUTS was assessed using the American Urological Association Symptom Index (AUASI), and additional survey data included age, race/ethnicity, and diagnosis of BPH.

Associations between drug exposures and prevalent LUTS were assessed using logistic regression models, expressed as odds ratios (ORs) with 95% confidence intervals (CIs). Primary analyses considered dichotomized AUASI, with 0 to 7 (mild) as reference vs 8 to 35 (moderate and severe), while secondary analyses stratified the latter group into moderate (8-19) and severe (≥20). Each drug category was assessed individually and collectively as a single indicator. Multivariable logistic regression models adjusted for age, race/ethnicity, region, and presence of BPH. The ORs and prevalence of drug exposures were used to estimate etiologic fraction.

Results. Baseline characteristics stratified by severity of LUTS demonstrated that older subjects displayed a progressively greater proportion of moderate to severe LUTS, with 10% of participants aged 70 to 74 years reporting severe LUTS. Asian Americans had a greater prevalence of mild LUTS, and African Americans had a greater proportion of moderate to severe LUTS.

Medication use varied by race/ethnicity ($P < .001$), with more Asian participants using antihistamines (16%) and African Americans using proportionately more diuretics (31%). Medication use increased with age ($P < .001$),

Table. Adjusted Association Between Medication Use and Lower Urinary Tract Symptoms (LUTS), Stratified by Presence of Benign Prostatic Hyperplasia (BPH), Among Participants in the California Men's Health Study

	Odds Ratio (95% CI, Wald Test)			
Medication Use	Not Adjusting for BPH, Adjusted[a]	Adjusting for BPH, Adjusted[b]	Stratified Without BPH, Adjusted[a]	Stratified With BPH, Adjusted[a]
Antihistamines	1.11 (1.06-1.17)	1.09 (1.04-1.15)	1.07 (1.01-1.13)	1.17 (1.05-1.31)
Bronchodilators	1.22 (1.15-1.29)	1.21 (1.14-1.28)	1.21 (1.13-1.29)	1.21 (1.07-1.36)
Sympathomimetics	1.10 (1.01-1.20)	1.09 (1.00-1.20)	1.13 (1.02-1.25)	0.96 (0.79-1.18)
Anticholinergics	0.96 (0.88-1.06)	0.94 (0.86-1.04)	0.92 (0.83-1.03)	1.00 (0.83-1.21)
Diuretics	1.15 (1.10-1.21)	1.19 (1.13-1.24)	1.25 (1.19-1.31)	0.98 (0.90-1.08)
Antidepressants	1.39 (1.32-1.47)	1.36 (1.29-1.44)	1.41 (1.33-1.50)	1.21 (1.07-1.35)

[a] Adjusted for age, race, region, and all medications simultaneously.
[b] Adjusted for age, race, region, benign prostatic hyperplasia, and all medications simultaneously.