Comparative assessment of digital and analog radiography: diagnostic accuracy, cost analysis and quality of care


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Using digital radiography in five types of examination including intravenous pyelography (IVP), upper gastrointestinal (GI), small bowel follow through (SBFT), hysterography, and abdominal angiography.

Type of intervention
Screening and diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
Patients requiring radiological examinations.

Setting
Hospital. The economic study was conducted in Lyon, France.

Dates to which data relate
Effectiveness and resource utilization data relating to conventional radiography were collected between May and December 1992, while the corresponding dates for the digital radiography were between February and July 1993. Effectiveness data regarding sensitivity, specificity, and receiving operating characteristics (ROC) analysis were extracted from studies published between 1985 and 1995. The fiscal year was 1993.

Source of effectiveness data
Effectiveness data were derived from a single study and a review of the literature, and also from authors’ assumptions.

Link between effectiveness and cost data
Costing was retrospectively performed on the same patient sample as that used in the effectiveness.

Study sample
Power calculations were not used to determine the sample size. The conventional group consisted of 150 patients with an average of 52 years before the implementation of digital radiography, while the digital group comprised 142 patients with an average age 53 years. A staff survey regarding the working conditions after the implementation of digital radiography was performed with 8 employees completing a questionnaire in June 1993. In addition twenty radiologists responded to a radiologist postal survey carried out among 30 radiologists.
Study design
This was a non-Randomized controlled trial with historical controls, carried out in a single centre. The duration of the follow-up was until discharge. No loss to follow-up was reported.

Analysis of effectiveness
The principle used in the analysis of effectiveness was intention to treat. Average (95% confidence intervals) waiting and procedure times were measured via a questionnaire completed for each patient by the auxiliary nurse and the technician. Working conditions and job interest were measured by a questionnaire using the criteria from the Accreditation Manual for Hospitals of the Joint Commission on Accreditation of Health Care Organisations and criteria from the Organisational Audit Programme of the King's Fund Centre, and were completed by nurses, physicians, and technicians. The diagnostic quality of the digital radiography was assessed by radiologists via a five-score scale. The study groups were comparable in terms of age and gender.

Effectiveness results
The conventional group had a mean (95% CI) procedure time of 61 (5) minutes in terms of all examinations versus 55 (3) minutes in the digital group (NS). The corresponding values for the waiting time were 50 (5) minutes and 32 (3) minutes, respectively (not significant). The staff survey showed an improvement in working conditions in terms of lower procedure times, greater availability for patients, and work safety, and demonstrated an increase in job interest after the introduction of digital radiology. The following results were reported based on the radiologist survey regarding diagnostic quality of the digital radiography: vascular procedures had a mean score of 4.8; neurological examinations such as myelography, 4.3; GI, 4.0; chest X-ray, 1.44; and skull radiographs, 2.4.

Clinical conclusions
"The analysis by type of examination showed that procedure times for celiac and mesenteric angiography, GI, and SBFT were reduced by 31, 10, and 12 min, respectively. Reduced waiting times were observed for celiac and mesenteric angiography and hysterography, which both took 24 min less."

Outcomes assessed in the review
Sensitivity, specificity, and ROC (receiving operating characteristics) analysis were estimated from a review of the literature.

Study designs and other criteria for inclusion in the review
The authors critically assessed the diagnostic accuracy of the identified articles using the McMaster University scale. The inclusion criteria were: measure of sensitivity, specificity, existence of gold standard, large spectrum of patients, setting of the study, reproducibility and precision, definition of normality, and contribution to the validity of a sequence of tests.

Sources searched to identify primary studies
The search strategy involved a search of the MEDLINE database, handsearches of Radiology, American Journal of Roentgenology and Investigative Radiology, and selection of references from identified articles.

Criteria used to ensure the validity of primary studies
Not reported.

Methods used to judge relevance and validity, and for extracting data
Not reported.
Number of primary studies included
A total of 1,263 papers were identified, of which 104 compared conventional and digital radiology, from which 17 articles were chosen after critical appraisal.

Methods of combining primary studies
Not reported.

Investigation of differences between primary studies
Not reported.

Results of the review
The sensitivity of conventional radiography had a range from 78.5% to 89% and for digital radiology sensitivity ranged from 48.8% to 96%. The specificity of conventional radiography had a range from 83.2% to 100% versus 72.3% to 100% for digital radiography. In terms of ROC analysis, the modalities were found to be equivalent in 9 studies, while each modality was found to be superior in 4 studies.

Methods used to derive estimates of effectiveness
Authors’ opinions after consultation with senior radiologists.

Estimates of effectiveness and key assumptions
The authors concluded that “the diagnostic accuracy of conventional and digital radiographs depended on the type of examinations assessed.”

Measure of benefits used in the economic analysis
No summary benefit measure was identified in the economic analysis, and only separate clinical outcomes were reported.

Direct costs
Costs were not discounted due to the short time frame of the study. Among resource utilisation items involved, only the quantities associated with film consumption (as the largest contributor to the variable cost) and number of examinations per year were systematically reported separately from the costs. The cost items were reported separately. The cost analysis covered the costs of film consumption (as the largest part of variable costs) and fixed costs including equipment, depreciation, and maintenance costs. The perspective adopted in the cost analysis was that of a hospital. The source of resource use and cost data was the study institution and authors’ assumptions. The price date was 1993. The cost analysis did not cover other variable costs including electricity, water, and developing or fixing products, since they were deemed to be negligible in this study.

Indirect Costs
Not considered.

Currency
French francs (Ffr). A conversion to US dollars was carried out.

Sensitivity analysis
No sensitivity analysis was performed.
Estimated benefits used in the economic analysis
Not applicable.

Cost results
The use of digital radiography was associated with a net annual saving of Ffr18,000 including tax ($3,600) and an additional fixed cost of Ffr271,000 including tax, resulting to a global additional cost of Ffr253,000 (U50,600).

Synthesis of costs and benefits
Not conducted.

Authors' conclusions
Digital radiography can be introduced into a large hospital to improve patient and staff conditions, at a higher cost than analog radiology, and depending on the type of examinations performed by the radiology department.

CRD COMMENTARY - Selection of comparators
The reason for the choice of the comparator is clear.

Validity of estimate of measure of effectiveness
The internal validity of the effectiveness results from the single study may have been weakened by the lack of a randomised design (although this was not possible for ethical and practical reasons). Detailed information is provided about the methods of the review of the medical literature.

Validity of estimate of measure of benefit
Since the study lacked a summary benefit measure, it should be considered as a cost-consequences study.

Validity of estimate of costs
Quantities were partially reported separately from the costs. Adequate details of methods of cost estimation were given. The study lacked a prospective cost analysis.

Other issues
As acknowledged by the authors, the lack of randomisation, sensitivity analysis, and statistical analysis of the costs mean that the results need to be treated with some caution. The issue of generalisability to other settings or countries was not addressed. A synthesis of costs and benefits were not performed.

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