Continuous speech recognition in MR imaging reporting: advantages, disadvantages, and impact
Ramaswamy M R, Chaljub G, Esch O, Fanning D D, vanSonnenberg E

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
Computerised continuous speech recognition was compared with conventional human transcription, for the production of written reports from dictation about the results of magnetic resonance imaging (MRI).

Type of intervention
Other: transcription of dictated diagnosis results.

Economic study type
Cost-effectiveness analysis.

Study population
The study population was radiologists producing MRI reports.

Setting
The setting was tertiary care. The study was conducted in Texas, USA.

Dates to which data relate
The effectiveness data for the intervention related to the period 1 February to 31 October 1997. The effectiveness data for the comparator related to the period 1 February to 31 October 1996. The resource use data were gathered during the same dates as for the effectiveness data. The authors did not state the price year used in the study, but the intervention was installed in February 1997.

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The costing was undertaken prospectively on the same sample as that used in the effectiveness analysis.

Study sample
Calculations to assess the power of the study sample to detect statistically significant differences, or the sample size required to detect an important difference, were not reported. The study sample used to assess the time taken and report appearance consisted of all adult MRI examinations during the study period. This was appropriate for the study question. A total of 5,072 intervention reports and 4,552 comparator reports were studied. The authors did not state whether any reports were excluded.
A sub-sample of 5 radiologists was used to test the accuracy of the computerised system. The authors reported that the sub-sample was representative and selected according to the availability. The sub-sample reflected a wide range of experience. All of the sub-sample were American born, and spoke English with no significant accent or speech impediment. The authors noted that 2 of the 44 radiologists dictating reports over the study period were not born in America and had learned English as a second language. In addition, the investigators reviewed a random sample of 100 reports in each study group for errors.

**Study design**
The single-centred study used a before-and-after design with historical controls. The duration of the follow-up started from the time the MRI was completed until a transcription of the preliminary report was available. The authors did not report any loss to follow-up. The authors did not report whether the investigators and participants were masked to the transcription method for either the study period, the review of the report data, or the data analysis.

**Analysis of effectiveness**
It was not reported whether all the MRI reports transcribed during the study period were included in the analysis. Overall, the computerised speech recognition system was used for 82% of the reports over the 9-month study period, after installation of the system. Human transcription was used for the remainder of the reports in this time period. It was unclear whether these latter reports were included in the analysis. The primary outcomes analysed were:

- the turnaround time of the report, defined as the time from examination to the completion of a report transcription and preliminary report availability;
- the accuracy of the computerised system, defined as a measure of the word recognition rate;
- the report appearance, defined in terms of the length (lines, words or characters) and errors (spacing, spelling, word omission or duplication) per 1,000 words of report text.

**Effectiveness results**
The mean turnaround time for preliminary reports was 43.6 hours for the computerised speech recognition system and 87.8 hours for human transcription.

The mean accuracy of the computerised system was between 92.7% for spontaneous dictation and 96.5% for dictation of a standardised report.

The mean report length was 60 words and 7.9 lines for the computerised speech recognition system, and 95 words and 13.6 lines for human transcription.

The error rate for irregular spacing was 8.0 per 1,000 words of text for the computerised system, and 0.3 per 1,000 words of text for human transcription.

The error rate for spelling was 0.8 per 1,000 words of text for the computerised system, and 3.0 per 1,000 words of text for human transcription.

The error rate for omissions and duplications was 1.0 per 1,000 words of text for the computerised system, and 0.3 per 1,000 words of text for human transcription.

**Clinical conclusions**
The authors concluded that continuous speech recognition markedly improved turnaround time.

**Measure of benefits used in the economic analysis**
The outcomes were reported in a disaggregated way and, as such, the study was a cost-consequences analysis.
Direct costs
The resource quantities and the costs were reported separately. The direct costs to the hospital were reported in the analysis. The direct costs included in the analysis were the cost of hardware, software, and telephone support and upgrades for the computerised system. The authors reported that the costs of system maintenance and training were excluded, because they were conducted by existing information staff at minimal use of their time. The cost of human transcription was estimated by multiplying the annual operating budget of the transcription pool of staff, by the proportion of time spent transcribing MRI reports.

Discounting was not performed, and the capital costs of the computer hardware and equipment were not annuitised over the life of the equipment. The authors did not report whether the annual budget of the transcription service included the equipment costs, or whether any equipment costs had been annuitised. The dates to which the price data referred were not reported, but the system was installed in February 1997.

Statistical analysis of costs
A statistical analysis of the costs was not reported.

Indirect Costs
The indirect costs were not included in the analysis.

Currency
US dollars ($). No currency conversions were reported.

Sensitivity analysis
A sensitivity analysis was not reported.

Estimated benefits used in the economic analysis
See the 'Effectiveness Results' section.

Cost results
The total cost of the computerised system was $10,000.

The total cost of human transcription was $12,000 per year.

Synthesis of costs and benefits
The costs and the benefits were not combined in this cost-consequences analysis.

Authors’ conclusions
Continuous speech recognition improved turnaround time and was cost-effective.

CRD COMMENTARY - Selection of comparators
The comparator was justified on the grounds that human transcription of dictated reports had been used before the introduction of continuous speech recognition. You should decide if this is a widely used intervention in your own setting.
Validity of estimate of measure of effectiveness
The study design was a before-and-after study using historical controls. The authors noted that there were changes in the organisation of the dictation and transcription services that could have affected the outcomes of the study. They consequently amended the outcome measure to control for this. The authors reported that other factors that could affect the turnaround time of the reports remained constant over the before-and-after study periods. They also noted that there were changes in the numbers of staff and reports between the before-and-after study periods, but did not report whether these were controlled for in the analysis. It was also not reported whether differences in the experience and training of the radiologists in the before-and-after study periods were investigated.

The authors did not report whether the investigators and participants were masked to the transcription method in the preparation, review or analysis of the reports and data. The authors only assessed the accuracy of the computerised system using a sample of 5 radiologists, and acknowledged that these might not have been representative of the study population. Errors in transcription were only assessed for a random sample of 100 reports in the before-and-after study periods. It was unclear whether the analysis of the computerised reports only included those prepared by the system, or also included human transcription in instances when the computerised system was unavailable due to network and server problems. The authors reported that these malfunctions were normally corrected within an hour, but did not report whether these malfunctions affected the primary outcome measures such as turnaround time. These factors mean that it is not possible to assess whether the analysis of effectiveness accounted for all potential biases or confounding factors.

The authors noted that they were not able to measure the turnaround time for producing a final report because of other organisational changes during the study period. This may mean that the measure of time used (to produce a preliminary report) may not be an accurate measure of outcome. The authors also noted that other impacts associated with computerised speech recognition transcription were not measured. These included an increased editing burden, and the impact on major dictation and transcription errors arising from time lags between dictation and report editing. The authors suggested that these errors could be reduced by the computerised system.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of health benefit. The analysis was therefore categorised as a cost-consequences study.

Validity of estimate of costs
The authors noted that some relevant costs were omitted from the analysis. They also stated that the cost of system maintenance and training by members of the hospital's information system department was not included, because the costs could not be accurately estimated. The costs included in the annual budget for human transcription were not reported, and the source of the unit costs used was unclear. A statistical analysis of the costs was not conducted. The dates to which the prices related were not reported, but the system was installed in February 1997. No sensitivity analysis of the costs or the quantities was conducted. The authors noted that the costs of a computerised speech recognition system would vary between settings, according to the size of the practice and pre-existing infrastructure.

Other issues
The authors made appropriate comparisons of their findings with those from other studies. The issue of generalisability to other settings was addressed descriptively. The authors do not appear to have presented their results selectively. The study compared human and computerised speech recognition transcription, and this was reflected in the authors’ conclusions. The authors noted that there were still a number of limitations in the use and acceptability of computerised speech recognition systems, which were not evaluated in the study.

Implications of the study
The authors suggested that continuous speech recognition was viable and cost-effective in their own MRI section. However, they cautioned that continuous speech recognition required further evolution in terms of increased accuracy, improved grammatical sense, and a more radiologist-friendly user interface. The authors also recommended further cost
analyses.

**Source of funding**
None stated.

**Bibliographic details**

**PubMedID**
10701598

**DOI**
10.2214/ajr.174.3.1740617

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Cost-Benefit Analysis; Documentation /economics /methods; Humans; Magnetic Resonance Imaging /economics /instrumentation; Medical Records Systems, Computerized /economics /instrumentation; Natural Language Processing; Radiology Information Systems /economics /instrumentation; United States

**AccessionNumber**
22000000450

**Date bibliographic record published**
31/10/2002

**Date abstract record published**
31/10/2002