Assessing automated external defibrillators in preventing deaths from sudden cardiac arrest: an economic evaluation

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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
The study considered the use of an on-site automated external defibrillator (AED) in a number of alternative settings (hospital, office buildings, apartment blocks, homes of high-risk patients and homes of the over 55 years). The AED is a device to be used by first responders to analyse heart rhythm and deliver shocks if needed.

Type of intervention
Other: Emergency care.

Economic study type
Cost-utility analysis.

Study population
The study population comprised a hypothetical cohort of new cardiac arrest patients in Ontario with a mean age of 69 (+/- 13) years.

Setting
The settings were hospitals, office buildings, apartment buildings and homes where two or more persons were trained in cardiopulmonary respiration. The economic analysis was carried out in Canada.

Dates to which data relate
The effectiveness data used to populate the model came from studies published between 1998 and 2005. The date to which the resource use referred was 2005. The unit cost data were obtained from personal communications. The price year was 2005.

Source of effectiveness data
The clinical parameters associated with the model included:

- the annual incidence of out-of-hospital cardiac arrest per 100,000 people,
- the number of in-hospital cardiac arrests per year,
- the annual incidence rate of cardiac arrest in high-risk individuals,
- the probability of shockable rhythm,
- the probability of survival for out-of-hospital cardiac arrest,
- the probability of survival for in-hospital cardiac arrest,
the odds ratio (survival to hospital discharge per minute of defibrillation time), and life expectancy years.

**Modelling**
The structure of the model was represented graphically. The sequences of actions of the model involved calling 911 (or code blue in hospital setting), initiating cardiopulmonary respiration, assessment by emergency medical services personnel (or code blue team in hospital settings) for shock treatment, transfer to the intensive care unit, and discharge home. The time horizon of the analysis was 5 years.

**Sources searched to identify primary studies**
The clinical effectiveness data were derived from published studies, but no details of the study designs were provided. In addition, the authors assumed that on-site availability of AEDs would reduce time to defibrillation, the probability of patients having a shockable rhythm, and that each minute reduction in time-to-defibrillation would improve survival in those patients with a shockable rhythm.

**Methods used to judge relevance and validity, and for extracting data**
No details of the methods used to identify or select the estimates included were reported. No inclusion criteria were specified. The methods used to select estimates were neither reported nor discussed.

**Measure of benefits used in the economic analysis**
The measure of benefits used was the quality-adjusted life-years (QALYs). The benefits were discounted at an annual rate of 3%. The utility weight was taken from a published source. No details of the methods used to derive this weight were reported.

**Direct costs**
The study reported the direct costs to the health care system. These were AEDs and training costs. Resource use and unit costs were obtained from key informants at the University Health Network and the Ministry of Government Services. The resources and the quantities were reported separately. The price year was identified. Discounting was not performed.

**Statistical analysis of costs**
The costs were treated deterministically.

**Indirect Costs**
In line with the perspective adopted, no productivity costs were considered.

**Currency**
Canadian dollars (CAD). The exchange rate to convert from US dollars ($) was CAD 1.00 = $0.86.

**Sensitivity analysis**
The authors investigated uncertainty related to variability in the data. One-way sensitivity analyses were performed to investigate the effects of changes in model clinical estimates. The parameters investigated included reduction in time-to-defibrillation, the probability of shockable rhythm, and the odds ratio of survival to hospital discharge per minute of defibrillation time.
Estimated benefits used in the economic analysis
The total number of QALYs in 5 years of deploying AEDs was 1,427 in hospitals, 65 in office buildings, 779 in apartment buildings, 714 in homes of high-risk patients and 2,336 in homes of people older than 55 years.

Cost results
The total costs of deploying AEDs was CAD 18,225,000 in hospitals, CAD 33,204,000 in office buildings, CAD 1,684,333,000 in apartment buildings, CAD 62,497,750 in homes of high-risk patients and CAD 3,553,550,000 in homes of people older than 55 years.

Synthesis of costs and benefits
The cost per QALY gained in the deployment of AEDs was:

in hospitals, CAD 12,768 in the base-case analysis; it varied from CAD 1,300 (best case) to CAD 60,408 (worst case);

in office buildings, CAD 511,766 in the base-case analysis; it varied from CAD 61,566 (best case) to CAD 660,343 (worst case);

in apartment buildings, CAD 2,163,355 in the base-case analysis; it varied from CAD 157,275 (best case) to CAD 16,748,551 (worst case);

in homes of high-risk patients, CAD 87,569 in the base-case analysis; it varied from CAD 6,387 (best case) to CAD 621,461 (worst case); and

in homes of people older than 55 years, CAD 1,529,371 in the base-case analysis; it varied from CAD 108,581 (best case) to CAD 11,840,288 (worst case).

Authors' conclusions
The deployment of automated external defibrillators (AEDs) in all public places is not a cost-effective approach to improving survival after a cardiac arrest. The best use of AEDs may be in hospitals and in homes of patients at high-risk for sudden cardiac death and who do not have an implantable cardiac defibrillator.

CRD COMMENTARY - Selection of comparators
The rationale for the choice of the comparator was clear as the absence of on-site AEDs is the standard situation in Ontario. You should decide whether this applies to your own setting.

Validity of estimate of measure of effectiveness
The sources of the clinical data were given. However, no systematic search for data was reported and only limited information on the primary sources was given. Some of the sources used were national statistics, which are generally valid. However, overall, an objective assessment of the validity of the clinical inputs was not possible.

Validity of estimate of measure of benefit
The estimation of health benefits (QALYs) was modelled. QALYs are an appropriate measure because they capture the impact of the intervention on quality of care and survival, which are the most relevant dimensions of health. The use of QALYs permits comparisons with the benefits of other health care interventions. However, the study did not report the methods used to obtain the utility weight, which means it is not possible to comment on the validity of the estimate.

Validity of estimate of costs
The analysis of the costs was consistent with the perspective adopted in the study. The price year and the source of data were provided. Resource consumption reflected the actual pattern of treatment in Ontario. The cost estimates are likely
to be specific to this area and the issue of generalisability of the study beyond the study setting was not addressed. Discounting was not performed, which was appropriate given the short time horizon considered for the cost estimation.

**Other issues**
The authors made comparisons of their results with those from other studies, stating that this piece of research conformed to the results of previous economic evaluations despite the different analytical frameworks. The results of the study do not appear to have been presented selectively and the authors' conclusions appear to be an adequate reflection of the scope of the analysis.

**Implications of the study**
The study suggests that indiscriminate deployment of AEDs is not a cost-effective means of improving the health outcomes of cardiac arrest. Their use should be restricted to emergency response programmes, high-risk sites (such as hospitals) and high-risk patients.

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**Bibliographic details**

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**Other publications of related interest**


**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Age Factors; Aged; Arrhythmias, Cardiac /therapy; Computer Simulation; Cost-Benefit Analysis; Death, Sudden, Cardiac /prevention & control; Defibrillators /economics; Female; Humans; Male; Models, Econometric; Ontario; Quality-Adjusted Life Years; Reproducibility of Results

**AccessionNumber**