Title: Automated External Defibrillators in Long-Term Care Facilities

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Context and Policy Issues:

Out-of-hospital and in-hospital survival after a patient suffers from cardiac arrest due to ventricular tachycardia (VT) or ventricular fibrillation (VF) is improved, in part, when the patient can be given early defibrillation.\(^1\) In 2002, it was estimated that Canadian survival rates of patients who suffered an out-of-hospital cardiac arrest was 5.0%.\(^4\)

A patient’s odds of survival after out-of-hospital cardiac arrest decreases by 5.5% for every minute he or she does not receive access to care, cardiopulmonary resuscitation (CPR), defibrillation, and advanced cardiac life support, otherwise known as the “Chain of Survival”.\(^1,5,6\) The “Chain of Survival” is promoted by several organizations including the Heart and Stroke Foundation of Canada\(^2\), American Heart Association,\(^6\) and the Medical Advisory Secretariat for the Ontario Ministry of Health and Long-Term Care for Ontario (MAS OHTAC).\(^7\)

Early access to defibrillation for patients suffering an out-of-hospital cardiac arrest is for a responder (i.e., person providing care to the person suffering from cardiac arrest) to use an automated external defibrillator (AED).\(^1,2\) An AED is a user-friendly device that is especially designed for non-health care provider responders. It allows the responder to deliver direct current (DC) shock when the patient’s heart rhythm demands it and prevents the administration of DC shock when the patient is not in VT or VF.\(^1\) AEDs guide the responder through voice and display prompts – thus, the responder does not require medical knowledge regarding the interpretation of the cardiac rhythm and DC shock administration.\(^1\) AEDs available in public places are intended for public use before the arrival of emergency medical services (EMS), with the purpose of increasing the odds of survival.\(^1\) Some provinces across Canada regulate the use of AEDs while other provinces do not.\(^2\)
A 2004 study using data contained in a Canadian database (n=1,636 cardiac arrests), reported that of the non-residential (i.e., not a private residence), out-of-hospital cardiac arrests reported nursing homes accounted for the highest incidence (5.9%). This finding was supported by at least one other study. A US study that focused on a rural location in Pennsylvania also found that extended care facilities incurred the most (52 of 85) recorded cardiac arrests (of out-of-hospital locations with at least two reported cardiac arrests).

Based on a telephone survey of 126 nursing homes in four major American cities, it was reported that of the 90 nursing homes who responded, 16.7% (CI 95%: 8.8 to 24.5) had early defibrillation capabilities via AEDs (6.7%) or manual defibrillators (10.0%) along with the necessary staff. While there was no significant correlation between pre-hospital cardiac arrest survival and the capability of early defibrillation capability (r=0.55, p=0.67), the authors concluded that more study was warranted and that the AEDs in nursing homes may improve survival.

It is debated whether AEDs should be placed into long-term care (LTC) facilities such as nursing homes. Given the incidence of cardiac arrests in nursing homes alone, it is reasonable to investigate whether AEDs used in these settings results in increased survival after a cardiac arrest. In fact, at least one state in the US has issued a regulation stating that LTC nursing facilities have at least one AED by November 30, 2005.

Research Questions:

1. What is the clinical effectiveness of using automatic external defibrillators in long-term care facilities?
2. What is the cost effectiveness of using automatic external defibrillators in long-term care facilities?

Methods:

A literature search was conducted on key health technology assessment resources, including PubMed, The Cochrane Library (Issue 2, 2007), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI's HTAIS, EuroScan, international HTA agencies, focused Internet search, and supplemented by hand searching the bibliographies of selected papers. Results include English language publications from 2002 to date.

Summary of findings:

1. What is the clinical effectiveness of using automatic external defibrillators in long-term care facilities?

No health technology assessments, systematic reviews, meta-analyses, or randomized controlled trials were found. The one observational study that was identified is summarized below.

In 2004, Shah et al. retrospectively examined the care that adults experiencing cardiac arrest received in a skilled nursing facility compared to the general community. Data collected was from a registry of EMS and hospital medical records of adults suffering cardiac arrests in
Rochester, New York. Patients experiencing the cardiac arrest received rehabilitation services at the facility or were long-term residents. From the cardiac registry, 42 of 539 (8.0%) cardiac arrests occurred within the facility. Residents of the facility were more likely to be older ($p<0.001$) and Caucasian ($p=0.002$) when compared to community-dwelling patients. Facility patients were excluded from the study if they had a do not resuscitate (DNR) order.

There was no difference between the groups regarding the witness of the cardiac arrest ($p=0.39$). While there was a significant difference in whether CPR was administered ($p<0.001$), with residents in facility being more likely to receive CPR prior to EMS arrival (38.0% facility residents versus 46.0% adults in the community), there were no differences between the two groups in whether there was early defibrillation prior to EMS arrival ($p=0.843$). In fact, none of the residents from the facility were defibrillated and only one adult in the community group was defibrillated. In addition, there was no difference between groups in EMS response time being less than or greater than nine minutes ($p=0.514$). There was, however, a significant difference in the initial cardiac rhythm as assessed by EMS ($p=0.049$); of note is that 17.0% of facility residents had VT/VF compared to 34.0% of adults in the community group. There was no difference between these groups in the return of spontaneous circulation (both approximately 20.0%, $p=0.164$) and one-year survival rates (2.0% for facility residents compared to 5.0% of adults in the community, $p=0.41$).

The authors concluded that it was concerning that more facility residents were not given CPR and that it is important to determine why eligible facility residents were not defibrillated. Further investigation revealed that only one skilled nursing facility had an AED during this study period. It is noted that data were limited to EMS and hospital records and that the facility medical records were not consulted. The authors reported that the sample size was small which diminished the power to detect significant differences between the populations; however, it does highlight the fact that many facility residents suffering from cardiac arrest did not receive CPR or defibrillation.

2. What is the cost effectiveness of using automatic external defibrillators in long-term care facilities?

No economic evaluations published in the last five years were found. However, an earlier study published in 2000 by Foutz and Sayre provided some relevant information regarding the cost-effectiveness of AEDs in LTC facilities in Cincinnati, Ohio. The authors reported that the cost per life saved would be US$ 87,837 per additional life saved.

This is based on a 25.0% survival rate of all cardiac arrests found in VF. The total cost for equipment and training over four years was US$ 439,185 (of which, $335,021 was equipment costs). Sensitivity analyses were conducted based on varying survival rates (ranging between 5.0% and 35.0%) and with costs calculated at one-half and two times the estimated costs. The cost per life saved ranged between US$ 62,741 and US$ 439,184 based on these different analyses.

The costs to obtain and maintain the AEDs were estimated along with the costs to educate and maintain the nursing staff. The time period was four years with costs discounted 5.0% from the previous year. The equipment costs were based one AED per 50 beds, for a total of 85 AEDs required. In addition, one nurse (either registered nurse or licensed practical nurse) per 50 beds was used to calculate the number of nurses required, for a total of 91 nurses required to ensure a trained nurse was on staff 24 hours a day. An hourly wage of $17.50 (the average starting wage of a registered nurse’s wage) with an additional 25.0% to account for the cost to the
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The estimated survival rate of patients found in VF was 25.0% (the authors believed this to be a conservative estimate). Patient survival was deemed to have occurred if the patient was alive at hospital discharge. Over the years that data was compiled (1994 to 1997), 160 out-of-hospital cardiac arrests occurred and without AEDs in the LTC facilities, survival rate for patients was 10.0% (of note, these patients were not in VF upon EMS arrival).

The authors stated that costs for hospitalization and care after discharge were not included in this analysis. Also, the impact on morbidity was not analyzed. The authors concluded that AEDs in LTC facilities has a reasonable cost-utility assuming a 25.0% survival rate can be accomplished.

Conclusions and Implications for Decision or Policy Making:

Given the lack of rigorous clinical or economic evidence, it is unclear whether AEDs are of clinical benefit or have good economic value if placed in LTC facilities. It may be that more relevant literature can be found if the literature search was expanded to include dates prior to 2002. However, searching these dates was beyond the scope of the current CADTH report and it may be difficult to generalize older reports to current LTC facilities for a variety of reasons (e.g., cost of machines, newer technology, newer guidelines, costs of salaries, health of residents in LTC facilities).

While LTC facilities have the highest incidence of out-of-hospital cardiac arrests, they also tend to house residents that are not typical of the general public. For example, at least one study has reported that a large proportion of residents in nursing homes have secured DNR directives which may significantly impact the clinical and economic benefit of AEDs. In addition, the resulting quality of life of LTC patients after surviving a cardiac arrest may be lower than the general population (or even lower than desired by the patient) which may inflate the costs incurred which in turn would compromise the overall clinical benefit and economic value of AEDs in LTC facilities.

Of note, the Heart and Stroke Foundation of Canada recommends that any person who, as a part of their job description as a professional primary health care provider or a professional first responder, has the duty to respond to a medical emergency should be authorized, trained, equipped, and directed to operate an AED safely and effectively. Such person could be any healthcare provider, or any first responder whose occupation or volunteer activities demand proficiency in the knowledge and skills of basic life support (BLS). This directive would likely include skilled long-term nursing facilities and other LTC facilities. Furthermore, the resuscitation guidelines reported in a paper from the United Kingdom stated that AEDs and programs are recommended for locations where the expected use of an AED for a witness cardiac arrest is more than one every two years.

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