|  |  |
| --- | --- |
| Question | |
| **Short PICO title here** | |
| **Population:** | Adults and children in out-of-hospital cardiac arrest settings |
| **CONCEPT:** | The benefits and harms of placing automatic external defibrillators (AEDs) in locked versus unlocked cabinets |
| **Main outcomes:** | Any outcome, including AED outcomes (e.g. AED use, time to AED use, AED vandalism or theft) |
| **Setting:** | Public access defibrillation |
| **Perspective:** | Rapid defibrillation is critical to improving patient outcomes |
| **Background:** | Concerns about theft, vandalism, and misuse of AEDs have led to the implementation of security measures, including the use of locked cabinets to house these devices in public areas.(O'Callaghan 2019 75, Fortington 2020 617, Lac 2023 100348) Field visits to AED locations, as recorded in registries or apps, have shown high proportions of AEDs in key-locked cabinets in some regions. While locked cabinets aim to protect AEDs, they may also cause delays in AED access during emergencies. No reviews have been conducted examining the impact of locked AED cabinets on patient or AED (e.g. theft, vandalism, and misuse) outcomes. |
| **Conflict of interests:** | Academic only: JB and GP are authors on included papers. |

# Assessment

|  |  |  |
| --- | --- | --- |
| Problem Is the problem a priority? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ø**Yes** ○ Varies ○ Don't know | Rapid defibrillation is critical to improving patient outcomes, as each minute of delay in attempting defibrillation reduces the chances of survival and good functional outcomes.(De Maio 2003 242, Drennan 2014 1623)  Patients who receive defibrillation from bystanders have the greatest chance of survival (Nehme 2019 85). Ensuring an AED’s accessibility and 24/7 availability during emergencies poses significant challenges. Concerns about theft, vandalism, and misuse of AEDs have led to the implementation of security measures, including the use of locked cabinets to house these devices in public areas(O'Callaghan 2019 75, Fortington 2020 617, Lac 2023 100348). While locked cabinets aim to protect AEDs, they may also cause delays in AED access during emergencies. There is emerging evidence of high proportions of AEDs locked in cabinets in some regions (Zhang 2019 120). AEDs cabinets are typically locked with a code or key. Additional security may also be present (e.g. locked in a room in a locked cabinet). | The BLS Task Force prioritized this topic, which has not been reviewed before, to address community concerns about the need for additional security measures to prevent AED theft, vandalism, and misuse(O'Callaghan 2019 75, Fortington 2020 617, Lac 2023 100348). |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial **ø** Small ○ Moderate ○ Large ○ Varies ○ Don't know | Ten articles fulfilled our eligibility criteria (Peberdy 2006 59, Ludgate 2012 , Benvenuti 2013 S69, Brugada 2014 S57, Telec 2018 181, Uhm 2018 534, Salerno 2019 1, Cheema 2022 S80, Ng 2022 97, Page 2024 110227).   * No studies examining patient outcomes were found. * The majority of studies reported low rates of theft and vandalism (<2.0%), (Peberdy 2006 59, Ludgate 2012 , Benvenuti 2013 S69, Brugada 2014 S57, Salerno 2019 1, Cheema 2022 S80, Page 2024 110227). The only study comparing unlocked and locked AED cabinets showed low rates of theft in both cabinet types, with the lowest rates seen in locked cabinets (0.3% vs. 0.1%)(Cheema 2022 S80). * Two simulation studies showed significantly slower AED retrieval when additional security measures were used, including locked cabinets (Telec 2018 181, Uhm 2018 534). * One survey of first responders reported half (24/45) were injured, most (62.5%) injuries occurred by using body parts to break the glass necessary to access a key to unlock the AED (NG 2022 97). | AEDs can be recovered through tracking devices (Page 2024 110227).  It is possible that some “stolen” AEDs were used in an emergency and not returned. |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial ○ Small ○ Moderate ○ Large ○ Varies **ø** Don't know | * No studies examining patient outcomes were found. * Locked cabinets can cause harm to rescuers (e.g. cuts from breaking glass) and some rescuers seem to have issues follow the unlocking instructions on cabinets (e.g. use of hammer rather than body parts to break glass to retrieve keys) (Yu 2022). * The cost to replace stolen or vandalized AEDs may be an issue in low-resource settings (e.g. community groups with limited funding). * AED retrieval was longer in two simulation studies when accessed through security measures including locked cabinets (Uhm 2008, Telec 2018). | Of 24 injured rescuers, one reported they would not be willing to access an AED in future emergencies as a result of the injuries sustained in AED retrieval (Yu 2022).  24/7 access to codes or keys to unlock cabinets is necessary.  AEDs in locked cabinets may make the public think they cannot use them.  To be effective, AEDs must be retrieved and used before EMS arrive. |
| Certainty of evidence What is the overall certainty of the evidence of effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Very low ○ Low ○ Moderate ○ High **ø No included studies** | N/A | While no evaluation of the certainty of evidence was performed, a high proportion of included studies were not peer-reviewed:   * Four papers were conference abstracts (Ludgate 2012 , Benvenuti 2013 S69, Brugada 2014 S57, Cheema 2022 S80) * Two were letters to the Editor (Salerno 2019 1, Page 2024 110227) |
| Values Is there important uncertainty about or variability in how much people value the main outcomes? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Important uncertainty or variability ○ Possibly important uncertainty or variability **ø** Probably no important uncertainty or variability ○ No important uncertainty or variability | Patients’ value longer term outcomes (Haywood 2018 e783, Haywood 2018 147). Patient outcomes and HRQoL was not addressed in the available studies.  The public are concerned about AED theft and vandalism. The cost to replace stolen or vandalized AEDs may be an issue in low-resource settings (e.g. community groups with limited funding). |  |
| Balance of effects Does the balance between desirable and undesirable effects favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison  ○  Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention Favors the intervention **ø Varies** ○ Don't know | The balance of effects is likely to vary depending on the setting.  Although theft and vandalism was seen in both locked and unlocked cabinets, the cost of replacement of AEDs in low resource settings may be prohibitive and if locked cabinets are not an option these setting may not purchase AEDs. | Some regions have opted to lock their public access defibrillators with a code that can be retrieved by calling the emergency number to encourage rescuers to call an ambulance as a first action.  A 2022 ILCOR Scientific Statement, which focuses on optimizing public access defibrillation, advises against using locked cabinets. If locked cabinets are used, instructions for unlocking them need to be clear and ensure no delays in access (Brooks 2022 204, Brooks 2022 204). |
| Resources required How large are the resource requirements (costs)?" | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs **ø Moderate costs** ○ Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ○ Don't know | There are costs associated with purchasing a locked cabinet and replacing a AED that is stolen or vandalized. |  |
| Certainty of evidence of required resources What is the certainty of the evidence of resource requirements (costs)? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Very low ○ Low ○ Moderate ○ High **ø No included studies** | No studies of resources or cost have been published. |  |
| Cost effectiveness Does the cost-effectiveness of the intervention favor the intervention or the comparison? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Favors the comparison ○ Probably favors the comparison ○ Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention **ø Varies** ○ No included studies | The cost-effectiveness of locked versus unlocked cabinets is unknown. | AED programs are cost-effective in high income regions (Andersen 2019 250). |
| Equity What would be the impact on health equity? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Reduced ○ Probably reduced ○ Probably no impact ○ Probably increased ○ Increased ○ Varies **ø  Don't know** | No studies have examined the impact on health equity. | Cost of replacing an AED lost to theft or vandalism may be an issue in low resource settings. |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes ○ Yes **ø Varies** ○ Don't know | The acceptability of locked and unlocked AED cabinets is likely to vary depending on the setting |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes **ø Yes** ○ Varies ○ Don't know | Locked and unlocked cabinet are already in use. |  |

# Summary of judgements

|  | **Judgement** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Problem** | No | Probably no | Probably yes | **Yes** |  | Varies | Don't know |
| **Desirable Effects** | Trivial | **Small** | Moderate | Large |  | Varies | Don't know |
| **Undesirable Effects** | Trivial | Small | Moderate | Large |  | Varies | **Don't know** |
| **Certainty of evidence** | **Very low** | Low | Moderate | High |  |  | No included studies |
| **Values** | Important uncertainty or variability | Possibly important uncertainty or variability | Probably no important uncertainty or variability | **No important uncertainty or variability** |  |  |  |
| **Balance of effects** | Favors the comparison | Probably favors the comparison | Does not favor either the intervention or the comparison | Probably favors the intervention | Favors the intervention | **Varies** | Don't know |
| **Resources required** | Large costs | Moderate costs | Negligible costs and savings | Moderate savings | Large savings | **Varies** | Don't know |
| **Certainty of evidence of required resources** | Very low | Low | Moderate | High |  |  | **No included studies** |
| **Cost effectiveness** | Favors the comparison | Probably favors the comparison | Does not favor either the intervention or the comparison | Probably favors the intervention | Favors the intervention | Varies | **No included studies** |
| **Equity** | Reduced | Probably reduced | Probably no impact | Probably increased | Increased | Varies | **Don't know** |
| **Acceptability** | No | Probably no | Probably yes | Yes |  | **Varies** | Don't know |
| **Feasibility** | No | Probably no | Probably yes | Yes |  | **Varies** | Don't know |

# Type of recommendation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Strong recommendation against the intervention | Conditional recommendation against the intervention | Conditional recommendation for either the intervention or the comparison | Conditional recommendation for the intervention | Strong recommendation for the intervention |
| ○ | ○ | **ø** | ○ | ○ |

# Conclusions

|  |
| --- |
| Recommendation |
| We advises against using locked cabinets (Good Practice Statement).  If locked cabinets are used, instructions for unlocking them must be clear and ensure minimal delays in access (Good Practice Statement).  Emergency Medical Services should devise strategies to return public access defibrillators when used (Good Practice Statement). |
|  |

|  |
| --- |
| Justification |
| Public defibrillation is associated with the best cardiac arrest outcomes, but AEDs must retrieved in time to be used. Existing evidence is poor, but suggests locked cabinets only slightly deter theft and vandalism, but may also cause delay in access and harm rescuers. In giving an option of locked cabinets, we recognize the cost of replacing of an AED may be prohibitive in some settings. |

|  |
| --- |
| Subgroup considerations |
| n/a |

|  |
| --- |
| Implementation considerations |
| Public awareness campaigns on the use of AEDs may deter theft and vandalism (Brugada 2014 S57). If locked cabinets are used, the methods for locking cabinets needs consideration. Delays in access should be minimal and unlocking cabinets should not result in harm to rescuers. The mechanism (e.g. keys, codes) for unlocking cabinets should be available 24/7 and easily obtainable. Where possible, codes should be integrated into AED registries and available in the emergency call.  Emergency Medical Services should devise strategies to return public access defibrillators when used.  Tracking devices may result in the return of stolen or missing AEDs. |

|  |
| --- |
| Monitoring and evaluation |
| AED registries should record whether AED cabinets are locked and monitor and report theft and vandalism. |

|  |
| --- |
| Research priorities |
| Peer-reviewed research and human studies are needed on this topic, particularly studies focusing on real-life retrieval and the impact of security strategies on delivery times and patient outcomes. |

# References Summary

Andersen, L. W., M. J. Holmberg, A. Granfeldt, L. P. James and L. Caulley (2019). "Cost-effectiveness of public automated external defibrillators." Resuscitation **138**: 250.

Benvenuti, C., R. Burkart and R. Mauri (2013). "Public defibrillators and vandalism: Myth or reality?" Resuscitation **1)**: S69.

Brooks, S. C., G. R. Clegg, J. Bray, C. D. Deakin, G. D. Perkins, M. Ringh, C. M. Smith, M. S. Link, R. M. Merchant, J. Pezo-Morales, M. Parr, L. J. Morrison, T.-L. Wang, R. W. Koster and M. E. H. Ong (2022). "Optimizing outcomes after out-of-hospital cardiac arrest with innovative approaches to public-access defibrillation: A scientific statement from the International Liaison Committee on Resuscitation." Resuscitation **172**: 204.

Brooks, S. C., G. R. Clegg, J. Bray, C. D. Deakin, G. D. Perkins, M. Ringh, C. M. Smith, M. S. Link, R. M. Merchant, J. Pezo-Morales, M. Parr, L. J. Morrison, T. L. Wang, R. W. Koster, M. E. H. Ong and R. International Liaison Committee on (2022). "Optimizing outcomes after out-of-hospital cardiac arrest with innovative approaches to public-access defibrillation: A scientific statement from the International Liaison Committee on Resuscitation." Resuscitation **172**: 204.

Brugada, R., A. Morales, R. Ramos, J. Heredia, E. R. De Morales and P. Batlle (2014). "Girona, cardio-protected territory." Resuscitation **1)**: S57.

Cheema, K., D. O'Connell, N. Herz, A. Adebayo, J. Thorpe, A. Benson-Clarke and G. Perkins (2022). "The influence of locked automated external defibrillators (AEDs) cabinets on the rates of vandalism and theft." Resuscitation **175(Supplement 1)**: S80.

De Maio, V. J., I. G. Stiell, G. A. Wells and D. W. Spaite (2003). "Optimal defibrillation response intervals for maximum out-of-hospital cardiac arrest survival rates." Annals of Emergency Medicine **42**(2): 242.

Drennan, I. R., S. Lin, K. E. Thorpe and L. J. Morrison (2014). "The effect of time to defibrillation and targeted temperature management on functional survival after out-of-hospital cardiac arrest." Resuscitation **85**(11): 1623.

Fortington, L. V., S. Bekker and C. F. Finch (2020). "Integrating and maintaining automated external defibrillators and emergency planning in community sport settings: a qualitative case study." Emerg Med J **37**(10): 617.

Haywood, K., L. Whitehead, V. M. Nadkarni, F. Achana, S. Beesems, B. W. Bottiger, A. Brooks, M. Castren, M. E. Ong, M. F. Hazinski, R. W. Koster, G. Lilja, J. Long, K. G. Monsieurs, P. T. Morley, L. Morrison, G. Nichol, V. Oriolo, G. Saposnik, M. Smyth, K. Spearpoint, B. Williams, G. D. Perkins and C. Collaborators (2018). "COSCA (Core Outcome Set for Cardiac Arrest) in Adults: An Advisory Statement From the International Liaison Committee on Resuscitation." Circulation **137**(22): e783.

Haywood, K., L. Whitehead, V. M. Nadkarni, F. Achana, S. Beesems, B. W. Bottiger, A. Brooks, M. Castren, M. E. H. Ong, M. F. Hazinski, R. W. Koster, G. Lilja, J. Long, K. G. Monsieurs, P. T. Morley, L. Morrison, G. Nichol, V. Oriolo, G. Saposnik, M. Smyth, K. Spearpoint, B. Williams, G. D. Perkins and C. Collaborators (2018). "COSCA (Core Outcome Set for Cardiac Arrest) in Adults: An Advisory Statement From the International Liaison Committee on Resuscitation." Resuscitation **127**: 147.

Lac, D., M. K. Wolters, K. H. B. Leung, L. MacInnes and G. R. Clegg (2023). "Factors affecting public access defibrillator placement decisions in the United Kingdom: A survey study." Resusc Plus **13**: 100348.

Ludgate, M. B., K. B. Kern, B. J. Bobrow and G. A. Ewy (2012). "Donating automated external defibrillators may not be enough." Circulation. Conference: American Heart Association **126**(21 SUPPL. 1).

Nehme, Z., E. Andrew, S. Bernard, B. Haskins and K. Smith (2019). "Trends in survival from out-of-hospital cardiac arrests defibrillated by paramedics, first responders and bystanders." Resuscitation **143**: 85.

NG, J. S. Y., HO, R.J.S., YU, J. ., NG, Y.Y. (2022). "Factors Influencing Success and Safety of AED Retrieval in out of Hospital Cardiac Arrests in Singapore." The Korean Journal of Emergency Medical Services **26**(2): 97.

O'Callaghan, P. A., J. Swampillai and M. K. Stiles (2019). "Availability of automated external defibrillators in Hamilton, New Zealand." N Z Med J **132**(1503): 75.

Page, G. and J. Bray (2024). "Unlocking the key to increasing survival from out-of-hospital cardiac arrest - 24/7 accessible AEDs." Resuscitation: 110227.

Peberdy, M. A., L. V. Ottingham, W. J. Groh, J. Hedges, T. E. Terndrup, R. G. Pirrallo, N. C. Mann and R. Sehra (2006). "Adverse events associated with lay emergency response programs: the public access defibrillation trial experience." Resuscitation **70**(1): 59.

Salerno, J., C. Willson, L. Weiss and D. Salcido (2019). "Myth of the stolen AED." Resuscitation **140**: 1.

Telec, W., A. Baszko, M. Dabrowski, A. Dabrowska, M. Sip, M. Puslecki, T. Klosiewicz, P. Potyrala, W. Jurczyk, A. Maciejewski, R. Zalewski, M. Witt, J. R. Ladny and L. Szarpak (2018). "Automated external defibrillator use in public places: a study of acquisition time." Kardiologia polska **76**(1): 181.

Uhm, T. H. and J. H. Kim (2018). "Factors affecting delivery time of public access defibrillator in apartment houses." Indian Journal of Public Health Research and Development **9(9)**: 534.

Zhang, L., B. Li, X. Zhao, Y. Zhang, Y. Deng, A. Zhao, W. Li, X. Dong and Z. J. Zheng (2019). "Public access of automated external defibrillators in a metropolitan city of China." Resuscitation **140**: 120.