|  |  |
| --- | --- |
| Question | |
| **Question: In adults and children with cardiac arrest, does the delivery (without dispatcher assistance) of continuous chest compressions with or without ventilations) compared with standard CPR by bystanders improve patient outcomes?** | |
| **Population:** | Adults and children with cardiac arrest |
| **Intervention:** | Continuous chest compressions with or without ventilations delivered by bystanders without dispatcher assistance |
| **Comparison:** | Standard CPR, defined as any compression-to-ventilation ratio delivered by bystanders without dispatcher assistance. Comparator groups that receive no CPR or mechanical CPR were excluded from the review. Studies reporting only unadjusted data for outcomes were excluded. |
| **Main outcomes:** | Favourable neurological survival (as measured by cerebral performance category or modified Rankin Score) at discharge or 30-days and at any time interval after 30-days; Survival to discharge or 30 days survival; Survival to any time interval after discharge or 30 days survival; Return of spontaneous circulation (ROSC); Quality of life as measured by any indicator or score. |
| **Setting:** | Out-of-hospital setting |
| **Perspective:** |  |
| **Background:** | This topic was prioritized for review due to the time since the previous systematic review.(Ashoor 2017 112) |
| **Conflict of interests:** | None |

# Assessment

|  |  |  |
| --- | --- | --- |
| Problem Is the problem a priority? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes **X** Yes ○ Varies ○ Don't know | Conventional cardiopulmonary resuscitation (C-CPR) consists of manual chest compressions and ventilation to maintain oxygenation until return of spontaneous circulation is achieved. Ventilations result in frequent interruptions in chest compressions, however, which can reduce coronary and aortic blood flow during cardiac arrest and has been associated with poorer survival in animal models (Kern 2002 645). Similarly, higher chest compression fraction (total resuscitation time spent performing chest compressions) has been associated with improved outcomes in observational studies (Christenson 2009 1241). One strategy to improve chest compression fraction and reduce interruptions in chest compression is to perform continuous chest compression (compression only CPR, CCO-CPR). However, there is also concern that CCO-CPR compression may be harmful for patients who require more effective ventilations, such as asphyxial arrests or drowning (Berg 2000 1743). |  |
| Desirable Effects How substantial are the desirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Trivial **X** Small ○ Moderate ○ Large ○ Varies ○ Don't know | Three observational studies compared bystander compression-only CPR (CCO-CPR) with conventional CPR (C-CPR) at a ratio of 15:2 (Bohm 2007 2908, Ong 2008 119) and 30:2 (Bobrow 2010 1447) in adults without dispatcher-assisted CPR (DA-CPR) instructions (DA-CPR). As 15:2 CPR is no longer recommended, all outcomes, including these studies, were downgraded for indirectness.  ***For the critical outcome of favorable neurological function,*** we identified no studies without dispatcher assistance. Indirect evidence of very-low certainty (downgraded for risk of bias, imprecision and indirectness) from one cohort study of combined bystander (76% of cases) and DA-CPR (24% of cases) suggests favorable neurological function (adjusted OR 2.22, 95%CI: 1.17 to 4.21) with CO-CPR compared to 15:2 CPR in 4,068 adult bystander-witnessed OHCAs.(SOS-Kanto Study Group 2007 920)  ***For the critical outcome of survival to hospital discharge or 30 days,*** we identified very-low certainty of evidence (downgraded for risk of bias, imprecision and indirectness) from three cohort studies.(Bohm 2007 2908, Ong 2008 119, Bobrow 2010 1447) One study in 5,272 adult presumed cardiac OHCAs reported significantly higher survival to hospital discharge with CCO-CPR compared to 30:2 CPR (adjusted OR 1.60, 95%CI: 1.08 to 2.35).(Bobrow 2010 1447) The remaining two studies, which examined all age OHCAs, reported no difference between the two CPR strategies for survival to 30 days and 15:2 CPR (adjusted OR 1.18, 95%CI: 0.89 to 1.56)(Bohm 2007 2908) or hospital discharge (adjusted OR 1.32, 95%CI: 0.35 to 4.94).(Ong 2008 119)  ***For the important outcome of survival to hospital admission,*** we identified very-low certainty of evidence (downgraded for risk of bias, imprecision and indirectness) from one cohort study.(Bohm 2007 2908) This all-age cohort study (n=11,275) reported no difference in ROSC with CCO-CPR compared to 15:2 CPR (adjusted OR 1.02, 95%CI: 0.60 to 1.73).(Ong 2008 119)  ***For the important outcome of ROSC,*** we identified very-low certainty of evidence (downgraded for risk of bias, imprecision and indirectness) from one cohort study.(Ong 2008 119) This all-age cohort study (n=441) reported no difference in ROSC with CCO-CPR compared to 15:2 CPR (adjusted OR 1.02, 95%CI: 0.60 to 1.73).(Ong 2008 119) | Given the included studies were conducted without dispatcher assistance, it could be assumed that the CPR was performed by CPR trained individuals or off-duty health care professionals.  Three additional studies reported no difference in unadjusted patient outcomes between CCO-CPR and C-CPR.(Waalewijn 2001 273, Panchal 2013 435)  One study conducted in the 1980’s, reported higher OHCA survival when 15:2 was correctly performed compared to incorrectly (31% vs 8%) or when compared to CCO-CPR (31% vs 20%).(Van Hoeyweghen 1993 47) Rates of correctly applied 15:2 were higher in bystanders who were healthcare professionals than lay bystanders (58% vs 42%).(Van Hoeyweghen 1993 47)  Three trials comparing DA-CPR CCO-CPR and C-CPR found no difference in patient outcomes. (Hallstrom 2000 1546, Rea 2010 423, Svensson 2010 434)  Two adult studies, which included DA-CPR, found no difference in good neurological outcomes between bystander CCO-CPR and C-CPR in respiratory/asphyxial OHCAs.(Fukuda 2017 493, Javaudin 2021 812)  A pilot RCT, including DA-CPR, showed no difference in survival at 1-day between CCO-CPR and C-CPR when delivered by trained laypersons.(Riva 2024 e010027)  Effective chest compressions generate cumulative coronary perfusion pressure, which falls to near zero when compressions stop. Therefore, early effective chest compressions are vital to establishing and maintaining coronary perfusion pressure.(Nassar 2017 1061) |
| Undesirable Effects How substantial are the undesirable anticipated effects? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large ○ Moderate ○ Small ○ Trivial **X**  Varies ○ Don't know | No undesirable effects were seen in adult populations.  No data in pediatric only populations was found. | A review found compression-only CPR results in a higher total number of chest compressions. However, as it continues, rescuers may experience fatigue, which can lead to a reduction in the depth of compressions compared to those delivered in conventional CPR with pauses for breaths.(Min Ko 2016 882)  Opening the airway and delivery of ventilations is technical, and bystanders, especially if untrained or minimally trained, are typically unable to deliver effective ventilations during simulated CPR.(Beard 2015 138) |
| Certainty of evidence What is the overall certainty of the evidence of effects? | | |
| Judgement | Research evidence | Additional considerations |
| **X**  Very low ○ Low ○ Moderate ○ High ○ No included studies | The certainty of evidence for all outcomes was very-low. Downgraded for risk of bias, imprecision and indirectness.  All data is observational and conducted in the era of 15:2 CPR. | The main TANGO-2 RCT currently underway will provide high-quality evidence on this issue for trained bystanders.(Riva 2024 e010027) |
| 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 ○ Probably no important uncertainty or variability **X** No important uncertainty or variability | The is no uncertainty, the COSCA document highlights the importance of good neurological outcomes.(Haywood 2018 e783, Haywood 2018 147) |  |
| 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 **X** Probably favors the intervention ○ Favors the intervention ○ Varies ○ Don't know | Despite the theoretical risk of suboptimal oxygenation in patients receiving CCO-CPR, there is no data suggesting a negative impact on patient outcomes. Given that CCO-CPR is easier to deliver and has resulted in increased rates of bystander CPR, the evidence probably favors CCO-CPR. Furthermore, standard CPR involving a compression-to-ventilation ratio is hard to achieve, and in practice may result in asynchronous ventilations.(Schmicker 2021 31) |  |
| Resources required How large are the resource requirements (costs)? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Large costs ○ Moderate costs **X** Negligible costs and savings ○ Moderate savings ○ Large savings ○ Varies ○ Don't know | Negligible impact on resources as both treatment strategies require similar investment in staff and resources. | It is possible the CCC is easier to teach and may be more practical in resource-limited environments. Data from one RCT (Nichol 2015 2203) and observation studies suggest that CCC is associated with more adherence to protocol compared to standard CPR.(Schmicker 2021 31) |
| 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 **X** No included studies | There were no economic evaluations of the two treatment strategies. |  |
| 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 **X** Does not favor either the intervention or the comparison ○ Probably favors the intervention ○ Favors the intervention ○ Varies ○ No included studies | CCC is likely to be as cost-effective as standard CPR. |  |
| Equity What would be the impact on health equity? | | |
| Judgement | Research evidence | Additional considerations |
| ○ Reduced ○ Probably reduced ○ Probably no impact **X**  Probably increased ○ Increased ○ Varies ○ Don't know | In the out-of-hospital hospital setting, it is likely that CCC would improve treatment equity compared to standard CPR though increases in CPR provided. |  |
| Acceptability Is the intervention acceptable to key stakeholders? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes **X** Yes ○ Varies ○ Don't know | Public surveys show chest-compression only CPR for strangers is preferable.(Cheskes 2016 253, Bray 2017 158) |  |
| Feasibility Is the intervention feasible to implement? | | |
| Judgement | Research evidence | Additional considerations |
| ○ No ○ Probably no ○ Probably yes **X** Yes ○ Varies ○ Don't know | The task force placed high value on the importance of providing high-quality chest compressions and simplifying resuscitation logistics for providers and noted the support for the clinical benefit of bundles of care involving minimally interrupted cardiac resuscitation. |  |

# 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** | Large | Moderate | **Small** | Trivial |  | 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 | **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 |
| ○ | ○ | **X** | ○ | ○ |

# Conclusions

|  |
| --- |
| Recommendation |
| We continue to recommend that chest compressions be performed for all adults in cardiac arrest (good practice statement).  We suggest that bystanders who are trained, able and willing give chest compressions with rescue breaths for adults in cardiac arrest (weak recommendation, very-low-certainty evidence). |
|  |
| Justification |
| In making these recommendations, the task force acknowledged the very-low-quality evidence and comparison to 15:2 CPR, but placed higher emphasis on the need to give chest compressions in adult CPR and the potential to increase rates of bystander CPR with the introduction of CCO- or compression-focused CPR in adults.(Bray 2011 1393, Kitamura 2012 2834, Iwami 2015 415, Malta Hansen 2015 255) The task force also considered:  • Bystander CPR more than doubles OHCA survival.(Sasson 2010 63) We placed a higher emphasis on providing any bystander CPR over rescue breaths in adults with non-asphyxial or drowning causes.  • Three additional studies reported no difference in unadjusted patient outcomes between CCO-CPR and C-CPR.(Van Hoeyweghen 1993 47, Waalewijn 2001 273, Panchal 2013 435)  • One of these studies conducted in the 1980’s, reported higher unadjusted survival when 15:2 was correctly performed compared to incorrectly (31%vs 8%) or when compared to CCO-CPR (31% vs 20%).(Van Hoeyweghen 1993 47) Rates of correctly applied 15:2 were higher in bystanders who were healthcare professionals than lay bystanders (58% vs 42%).(Van Hoeyweghen 1993 47)  • Given the included studies were conducted without dispatcher assistance, it could be assumed that the CPR was performed by CPR trained individuals or off-duty health care professionals.  • In systems with EMS, dispatchers can provide DA-CPR instructions if it is determined in the emergency call that ventilations are required (e.g. long EMS response time).  • Indirect evidence from three RCTs comparing CCO-CPR with C-CPR in dispatcher CPR instructions reported no difference in patient outcomes.(Hallstrom 2000 1546, Rea 2010 423, Svensson 2010 434)  • Increases in rates of bystander CPR and patient outcomes have been reported following the introduction of CCO- or compression-focused CPR in adults.(Bray 2011 1393, Kitamura 2012 2834, Iwami 2015 415, Malta Hansen 2015 255) Public surveys show chest-compression only CPR for strangers is preferable.(Cheskes 2016 253, Bray 2017 158)  • Most bystander CPR for adults is given DA-CPR instructions, even in the presence of CPR-trained lay bystanders.(Riva 2024 e010027)  • Two included studies suggest no difference in patient outcomes for bystander-only CCO-CPR and C-CPR at 15:2 by duration of EMS response.(Bohm 2007 2908, Ong 2008 119)  • Effective chest compressions generate cumulative coronary perfusion pressure, which falls to near zero when compressions stop. Therefore, early effective chest compressions are vital to establishing and maintaining coronary perfusion pressure.(Nassar 2017 1061)  • Two adult studies, which included DA-CPR, found no difference in good neurological outcomes between bystander CCO-CPR and C-CPR in respiratory/asphyxial OHCAs.(Fukuda 2017 493, Javaudin 2021 812)  • A pilot RCT, including DA-CPR, showed no difference in survival at 1-day between CCO-CPR and C-CPR when delivered by trained laypersons.(Riva 2024 e010027)  • A review found compression-only CPR resulted in a higher total number of chest compressions. However, as it continues, rescuers may experience fatigue, which can reduce the depth of compressions compared to those delivered in conventional CPR with pauses for breaths.(Min Ko 2016 882)  • Opening the airway and delivery of ventilations is technical, and bystanders, especially if untrained or minimally trained, are typically unable to deliver effective ventilations during simulated CPR.(Beard 2015 138) |

|  |
| --- |
| Subgroup considerations |
|  |
| Implementation considerations |
|  |

|  |
| --- |
| Monitoring and evaluation |
|  |
| Research priorities |

* There is a lack of research comparing compression-only CPR to 30:2 CPR without dispatcher assistance.
* There is a lack of data in pediatric populations.

**References**

Ashoor, H. M., E. Lillie, W. Zarin, B. Pham, P. A. Khan, V. Nincic, F. Yazdi, M. Ghassemi, J. Ivory, R. Cardoso, G. D. Perkins, A. R. de Caen, A. C. Tricco and I. B. L. S. T. Force (2017). "Effectiveness of different compression-to-ventilation methods for cardiopulmonary resuscitation: A systematic review." Resuscitation **118**: 112.

Beard, M., A. Swain, A. Dunning, J. Baine and C. Burrowes (2015). "How effectively can young people perform dispatcher-instructed cardiopulmonary resuscitation without training?" Resuscitation **90**: 138.

Bobrow, B. J., D. W. Spaite, R. A. Berg, U. Stolz, A. B. Sanders, K. B. Kern, T. F. Vadeboncoeur, L. L. Clark, J. V. Gallagher, J. S. Stapczynski, F. LoVecchio, T. J. Mullins, W. O. Humble and G. A. Ewy (2010). "Chest compression-only CPR by lay rescuers and survival from out-of-hospital cardiac arrest." JAMA **304**(13): 1447.

Bohm, K., M. Rosenqvist, J. Herlitz, J. Hollenberg and L. Svensson (2007). "Survival Is Similar After Standard Treatment and Chest Compression Only in Out-of-Hospital Bystander Cardiopulmonary Resuscitation." Circulation **116**(25): 2908.

Bray, J. E., K. Smith, R. Case, S. Cartledge, L. Straney and J. Finn (2017). "Public cardiopulmonary resuscitation training rates and awareness of hands-only cardiopulmonary resuscitation: a cross-sectional survey of Victorians." Emerg Med Australas **29**(2): 158.

Cheskes, L., L. J. Morrison, D. Beaton, J. Parsons and K. N. Dainty (2016). "Are Canadians more willing to provide chest-compression-only cardiopulmonary resuscitation (CPR)?—a nation-wide public survey." CJEM **18**(4): 253.

Fukuda, T., N. Ohashi-Fukuda, Y. Kondo, T. Sera and N. Yahagi (2017). "Effect of rescue breathing by lay rescuers for out-of-hospital cardiac arrest caused by respiratory disease: a nationwide, population-based, propensity score-matched study." Intern Emerg Med **12**(4): 493.

Hallstrom, A., L. Cobb, E. Johnson and M. Copass (2000). "Cardiopulmonary resuscitation by chest compression alone or with mouth-to-mouth ventilation." N Engl J Med **342**(21): 1546.

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.

Javaudin, F., J. Raiffort, N. Desce, V. Baert, H. Hubert, E. Montassier, C. Le Cornec, J. B. Lascarrou, Q. Le Bastard and G. R. ReAC (2021). "Neurological Outcome of Chest Compression-Only Bystander CPR in Asphyxial and Non-Asphyxial Out-Of-Hospital Cardiac Arrest: An Observational Study." Prehosp Emerg Care **25**(6): 812.

Min Ko, R. J., V. X. Wu, S. H. Lim, W. W. San Tam and S. Y. Liaw (2016). "Compression-only cardiopulmonary resuscitation in improving bystanders’ cardiopulmonary resuscitation performance: a literature review." Emergency Medicine Journal **33**(12): 882.

Nassar, B. S. and R. Kerber (2017). "Improving CPR performance." Chest **152**(5): 1061.

Ong, M. E., F. S. Ng, P. Anushia, L. P. Tham, B. S. Leong, V. Y. Ong, L. Tiah, S. H. Lim and V. Anantharaman (2008). "Comparison of chest compression only and standard cardiopulmonary resuscitation for out-of-hospital cardiac arrest in Singapore." Resuscitation **78**(2): 119.

Panchal, A. R., B. J. Bobrow, D. W. Spaite, R. A. Berg, U. Stolz, T. F. Vadeboncoeur, A. B. Sanders, K. B. Kern and G. A. Ewy (2013). "Chest compression-only cardiopulmonary resuscitation performed by lay rescuers for adult out-of-hospital cardiac arrest due to non-cardiac aetiologies." Resuscitation **84**(4): 435.

Rea, T. D., C. Fahrenbruch, L. Culley, R. T. Donohoe, C. Hambly, J. Innes, M. Bloomingdale, C. Subido, S. Romines and M. S. Eisenberg (2010). "CPR with chest compression alone or with rescue breathing." N Engl J Med **363**(5): 423.

Riva, G., E. Boberg, M. Ringh, M. Jonsson, A. Claesson, A. Nord, S. Rubertsson, H. Blomberg, P. Nordberg, S. Forsberg, M. Rosenqvist, L. Svensson, C. Andrell, J. Herlitz and J. Hollenberg (2024). "Compression-Only or Standard Cardiopulmonary Resuscitation for Trained Laypersons in Out-of-Hospital Cardiac Arrest: A Nationwide Randomized Trial in Sweden." Circ Cardiovasc Qual Outcomes **17**(3): e010027.

Schmicker, R. H., G. Nichol, P. Kudenchuk, J. Christenson, C. Vaillancourt, H. E. Wang, T. P. Aufderheide, A. H. Idris and M. R. Daya (2021). "CPR compression strategy 30:2 is difficult to adhere to, but has better survival than continuous chest compressions when done correctly." Resuscitation **165**: 31.

SOS-Kanto Study Group (2007). "Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study." Lancet **369**(9565): 920.

Svensson, L., K. Bohm, M. Castren, H. Pettersson, L. Engerstrom, J. Herlitz and M. Rosenqvist (2010). "Compression-only CPR or standard CPR in out-of-hospital cardiac arrest." N Engl J Med **363**(5): 434.

Van Hoeyweghen, R. J., L. L. Bossaert, A. Mullie, P. Calle, P. Martens, W. A. Buylaert and H. Delooz (1993). "Quality and efficiency of bystander CPR. Belgian Cerebral Resuscitation Study Group." Resuscitation **26**(1): 47.

Waalewijn, R. A., J. G. Tijssen and R. W. Koster (2001). "Bystander initiated actions in out-of-hospital cardiopulmonary resuscitation: results from the Amsterdam Resuscitation Study (ARRESUST)." Resuscitation **50**(3): 273.