PREHOSPITAL CARE

Systematic review of interventions to reduce delay in patients with suspected heart attack

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Emerg Med J 2004;**000**:1–6

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Accepted for publication 23 February 2004

Objectives: To evaluate the effectiveness of interventions aiming to reduce the time from the onset of signs and symptoms of an acute myocardial infarction (AMI) to seeking medical help/arrival at hospital.
Methods: A systematic review was carried out. Fifteen electronic databases, the internet, and the bibliographies of included studies were searched, and experts in the field of cardiac care were contacted. Randomised controlled trials (RCTs), controlled trials, and before and after studies conducted in any setting that assessed an intervention aimed at reducing the time from the onset of signs and symptoms of an AMI to seeking medical help and/or arrival in hospital were eligible for inclusion. Interventions could target people of any age at an increased risk of an AMI or the whole community.
Results: Eleven media/public education intervention studies met the inclusion criteria. Five (one controlled and four before and after studies) reported the interventions to have statistically positive effects on delay time, five (two RCTs and three before and after studies) reported no statistically significant effect, and the remaining before and after study did not conduct any statistical analysis. Three (one RCT and two before and after studies) of five studies evaluating the effect of the intervention on emergency department visits reported an increase in this outcome as a result of the intervention, and both studies (one RCT and one before and after study) examining calls made to emergency switchboards reported an increase in this outcome after the intervention.
Conclusions: There was little evidence that media campaigns and other public health interventions reduced delay. There is some evidence that they may result in an increase in emergency switchboard calls and emergency department visits. However, despite substantial expenditure of time and effort, methodological deficiencies of the studies mean that it is not possible to make definitive recommendations.

Acute myocardial infarction (AMI) is the major cause of premature mortality in the UK and other western countries.[1 2] Thrombolytic therapy provides considerable reduction in damage to the heart[3] but its effectiveness is dependent on prompt administration. There is a need for prompt action by people with symptoms of AMI or members of the public witnessing an AMI, and this has lead to widespread use of public education programmes designed to reduce the period between the onset of symptoms and treatment. This period consists of three different components: patient delay time, transport time, and hospital time from admission to treatment.[4] Patient delay time has been defined as the time from onset of signs and symptoms of an AMI to the time when medical assistance is sought[5] and is thought to account for most of the delay.[6] Patient delay time combined with transport time is referred to as prehospital delay time.

The UK National Service Framework (NSF) for coronary heart disease (CHD) reports that between a third and two thirds of deaths from AMI take place outside hospital.[1] There is an even greater problem with patients under 55 years of age where 90% of deaths from AMI occur before they arrive at hospital, with 40% delaying more than four hours.[7] Only about 25% of infarct patients receive thrombolytic therapy. This figure would increase if delays were shortened, with a corresponding increase in life expectancy.[8] Those who call an ambulance arrive at hospital, on average, one hour earlier than those who call their GP.[9] The NSF recommends local public education programmes encouraging people to call an ambulance in the event of symptoms suggestive of myocardial infarction. However, the effectiveness of interventions to reduce delay time is uncertain.[4] We conducted a systematic review to investigate the effectiveness of interventions aiming to reduce patient and/or prehospital delay time.

METHODS

The review was undertaken according to the Centre for Reviews and Dissemination's Guidance for those Carrying Out or Commissioning Reviews.[10]

Search strategy

We searched the following databases: Applied Social Sciences Index and Abstracts (1987–2001), Cochrane Controlled Trials Register (Cochrane Library, 2000 issue 4), Cumulative Index to Nursing and Allied Health Literature (CINAHL, 1982–2000), Database of Abstracts of Reviews of Effectiveness (Cochrane Library, 2000 issue 4), EMBASE (1980–2000), Educational Resources Information Center (ERIC, 1966–2001), Medline (1966–2000), Mental Health Abstracts (1969–2001), National Research Register (NRR, 2000 issue 4), NHS Economic Evaluation Database (Cochrane Library, 2000 issue 4), PsycINFO (1987–2001), Science Citation Index (1974–2001), System for Information on Grey Literature in Europe (SIGLE, 1976–2001), Social Science Citation Index (1972–2001), and Sociological Abstracts (1963–2000). The internet and the bibliographies of included studies were also searched and experts in the field of cardiac care were contacted to identify any other relevant trials. We considered studies in all languages regardless of publication status. Full details of the search strategy are available from the authors.

Abbreviations: RCT, randomised control file; AMI, acute myocardial infarction

Study selection
Studies were included if they assessed an intervention aimed at reducing the time from the onset of signs and symptoms of an AMI to seeking medical help and/or arrival in hospital, reported either patient and/or prehospital delay as the outcome, and were randomised controlled trials (RCTs), controlled trials, or before and after studies. Articles were assessed for inclusion independently by two reviewers. Disagreements were resolved through discussion and, if necessary, by recourse to a third reviewer.

Data extraction and quality assessment
Data extraction and quality assessment were carried out by one reviewer and checked by a second reviewer. Disagreements were resolved through discussion and, if necessary, by recourse to a third reviewer. Study validity was assessed using a checklist adapted from CRD's Guidance for those Carrying Out or Commissioning reviews[10] and a previous systematic review examining interventions for increasing screening uptake (box).[11] Where a study had multiple publications, all papers were examined to ensure that all relevant data were extracted. If necessary, we contacted study authors for additional information and data.

Data analysis
Studies were synthesised in a narrative format along with appropriate summary tables.

RESULTS
Eleven studies, all evaluating media/public education campaigns, met the inclusion criteria (full study details and findings can be found on line http://www.emjonline.com/supplemental).[12–22] One of these studies also examined one to one education.[22] Two were RCTs,[21 22] one was a controlled trial,[20] and eight were before and after studies.[12–19] One RCT[22] had nine associated publications,[23–31] the other RCT[21] had two associated publications,[32 33] and one before and after study[13] had seven associated publications.[34–40] Table 1 summarises the duration of the intervention and outcome measurement of the studies. Campaign length varied from one week to 32 months, and there was a large variation in the duration of the pre-intervention, intervention, and post-intervention measurement periods.

Table 2 summarises the content of the interventions. All interventions, except one that did not provide any information relating to intervention content,[16] emphasised the importance of quick action, but varied with regard to use of a specific slogan and emphasis of other factors, namely signs of an AMI, the importance of calling emergency services, and treatment. The primary outcome examined in all the studies was patient and/or prehospital delay. Other outcomes examined were mortality rates and the use of health resources including emergency department visits, calls to emergency switchboards, and the use of ambulance/medic transport.

Checklist for assessing study validity

RCTs

1 Random selection of intervention and control groups
2 Concealment of allocation

RCTs and controlled trials

1a Comparability at baseline

(If ''no'' go to 1b, otherwise go to 2a)

1b Adjustment for confounding factors
2a Identical treatment of groups other than intervention

(If ''no'' go to 2b, otherwise go to 3)

2b Adjustment for any confounding factors
3 Outcome assessors blinded to intervention allocation
4 Reporting of method for measuring delay time
5 Percentage of missing data
6 Power calculation
7 Appropriateness of statistical analysis

Before and after studies

1 Reporting of method for measuring delay time
2 Adjustment for confounding factors
3 Power calculation
4 Appropriateness of statistical analysis

Prehospital and patient delay time
Two RCTs[21 22] and six before and after studies[13 14 16–19] examined prehospital delay. Three of the before and after studies reported a reduction in delay after the intervention: median delay time decreased from 4 to 2.9 hours ($p = 0.007$) in one study,[16] from 3 hours to 2 hours and 20 minutes ($p<0.001$) in another study,[13] and by 25 minutes in the third study ($p<0.001$).[14] In one of these studies there was also an increase from 15.5% to 23.2% ($p = 0.01$) in the percentage of persons delaying less than one hour, and from 58.5% to 66.0% ($p = 0.05$) in those delaying less than six hours.[16] Another before and after study reported an increase from 15.8% to 31.3% ($p<0.05$) in the percentage of persons delaying two hours or less.[17] Neither of the RCTs reported any statistically significant effects of the intervention. This was also the case for two of the before and after studies.[18 19] However, one of these before and after studies did show a reduction in median delay from 4.2 to 2.8 hours, but no statistical analysis was conducted.[19]

The controlled trial[20] and three before and after studies[12 14 15] examined patient delay. The controlled trial reported an increase in the percentage of patients in the intervention group calling their general practitioner within 30 minutes after the intervention (37%) compared with before the intervention ((24%) $p<0.05$)). However, these findings were not compared with the control group—differences in delay time between pre-intervention and post-intervention periods were calculated separately for the control and intervention group. Only one of the before and after studies found a significant reduction in median delay from 86.5 to 60 minutes ($p<0.001$).[14] The other two before and after studies found no statistically significant difference in the percentage of people seeking help within different time periods[12 15] or in median delay.[12]

In summary; five studies (one controlled trial and four before and after studies) reported the interventions to have a statistically positive effect on delay time, and six studies showed no statistically significant effect of the intervention.

Use of health resources
Two RCTs[21 22] and three before and after studies[13 14 18] examined the effect of the intervention on emergency department visits. One RCT reported a statistically significant increase in the overall number of visits for chest pain throughout the campaign period (no figures given),[21] one before and after study reported an increase in mean number of visits per day from 10 to 25 ($p<0.001$),[13] and another before and after study showed an increase in the mean

Table 1 Duration of the intervention and outcome measurement of included studies

Reference, country	Intervention period	Pre-intervention measurement period	Intervention measurement period	Post-intervention measurement period (time to commencement after intervention ceased)
RCTs				
Meischke *et al*, 1997,[21] USA	7 wk+10 m	None	10 m	14 m
Luepker *et al*, 2000,[22] USA	18 m	4 m	18 m	None
Controlled trial				
Rowley *et al*, 1982,[20] England	32 m	3 m	32 m	None
Before and after studies				
Mitic and Perkins, 1984,[17] Canada	8 wk	4 wk	8 wk	1 wk (3 m)
Ho *et al*, 1989,[15] USA	2 m	4.5 m	None	4.5 m
Moses *et al*, 1991,[18] USA	24 m	12 m	24 m	None
Rustige *et al*, 1992,[19] Germany	9 m (1st period) 18 m (2nd period)	6 m	9 m	6 m (after 1st period) 18 m (ongoing with 2nd period)
Bett *et al*, 1993,[12] Australia	1 wk	2 m	None	1 m (1 m)
Blohm *et al*, 1994,[13] Sweden	14 m	21 m	14 m	36 m
Gaspoz *et al*, 1996,[14] Switzerland	12 m	12 m	12 m	None
Maeso-Madronero *et al*, 2000,[16] Germany	6 m	6 m	6 m	None

m, month(s); wk, week(s).

number of visits per week from 22.2 to 49 ($p<0.005$).[14] Not enough information was provided in the studies to determine the proportion of those presenting with chest pain that were confirmed to have AMI.

One RCT[21] and one before and after study[14] examined calls made to emergency switchboards. Both found significant increases in the number of calls made after the intervention, with the before and after study reporting an increase from 13% to 20% ($p<0.001$). No figures were given for the RCT.

None of the three before and after studies examining use of ambulance/medic transport reported a statistically significant difference in this outcome from before to after the intervention.[13–15]

Mortality rate

One RCT[22] and one before and after study[13] examined mortality rates. Neither reported any trends or significant effects of the intervention on mortality.

Table 2 Summary of the key factors of the intervention content of included studies

Reference, country	Importance of quick/immediate action	Emphasis of signs and symptoms of AMI	Importance of calling emergency services	Emphasis of treatment such as lysis	Use of a specific slogan
RCTs					
Meischke *et al*, 1997,[21] USA	Y	Y	Y	Y	Y
Luepker *et al*, 2000,[22] USA	Y	Y	Y	Y	N
Controlled trial					
Rowley *et al*, 1982,[20] England*	Y	N	Y	N	Y
Before and after studies					
Mitic and Perkins, 1984,[17] Canada	Y	Y	Y	N	N
Ho *et al*, 1989,[15] USA	Y	Y	Y	N	Y
Moses *et al*, 1991,[18] USA	Y	Y	N	N	N
Rustige *et al*, 1992,[19] Germany	Y	Y	N	N	N
Bett *et al*, 1993,[12] Australia	Y	N	N	Y	Y
Blohm *et al*, 1994,[13] Sweden	Y	N	Y	N	Y
Gaspoz *et al*, 1996,[14] Switzerland	Y	N	Y	Y	Y

The before and after study of Maeso-Madronero *et al*, 2000,[16] Germany, did not provide any details on intervention content. Y, yes; N, no. *Signs and symptoms of an AMI was not a key factor, but intervention content did emphasise chest pain.

Table 3 Quality assessment for the RCTs and the controlled trial

Reference, country	Random selection of groups	Concealment of allocation	Comparability at baseline	Identical treatment of groups	Blinding of outcome assessors	Reporting of method for measuring delay	% Missing data	Power calculation	Appropriate statistical analysis
RCTs									
Meischke *et al*, 1997,[21] USA	Y	NR	Y	Y	NR	Y	I+C: 31%	Y	Y
Luepker *et al*, 2000,[22] USA	Y	NR	Y	Y	NR	Y	I: 27.2% C: 28.3%	Y	Y
Controlled trial									
Rowley *et al*, 1982,[20] England	N/A	N/A	Y	Y	NR	N	NR	NR	NR

Y, yes; N, no; N/A, not applicable; NR, not reported or insufficient information; I, intervention, C, control.

Study quality

The methodological quality of the included studies was generally not high. Results of the quality assessment are shown in table 3 for the trials and in table 4 for the before and after studies.

Some studies were flawed with regard to the sample that was used. For example, in one study there were significantly more individuals in the pre-message period with a discharge diagnosis of AMI and a history of AMI or angina than in the post-message period.[15] In another study different coronary care units were used in pre-intervention and post-intervention surveys.[12] These potential confounders were not controlled for in the analysis.

Another limitation was the broad inclusion criteria used in some studies. For example, in one study participants were included if they reported to the emergency department with one or more of 80 possible complaints including symptoms such as neck pain, indigestion, jaw pain, and stomach pain.[18]

Some studies were inadequate with regard to the statistical analyses carried out. Three studies, for example, failed to report any statistical analysis with regard to the main outcome of interest, delay time.[12 18 19] In the controlled study, only within group comparisons were conducted with regard to delay time, therefore it is not possible to determine if there were any differences in delay time between the control and intervention groups.[20] As with the before and after studies, the observed reduction in delay time may have been attributable to some other confounding factor rather than the intervention itself.

Some studies were limited with regard to outcome assessment. Five studies measured delay time during the intervention as compared with after the intervention had ended.[14 16 18 20 22] Hence it was only possible to determine if the intervention was effective in the time period in which it was running. Any longer term effects of the intervention would have remained undetected in these studies. In one RCT no baseline measurements of delay time were taken.[21]

In addition, some studies reported little information about the content of the intervention or about the participants included.[16 19]

DISCUSSION

There is limited evidence that community wide media based or one to one educational interventions were successful in reducing delay time and they may have resulted in an increase in calls made to emergency switchboards and emergency department visits. However, because of the types of study designs used and the methodological deficiencies of these studies, it is unclear how much weight can be given to these findings. The evidence for the effectiveness of the interventions came mainly from before and after studies suggesting a need for caution in attributing any reported effects to the actual intervention. A recently published review of eight mass media interventions (all of which were also identified and included in our systematic review) reported similar findings with regard to delay time.[41]

Studies that were effective in reducing delay time appeared similar to those that were ineffective in terms of population, duration of the intervention, the main outcome measured, baseline delay time, and the year in which the study was conducted. Four of the six studies that reported the intervention to have no effect on delay concluded that a

Table 4 Quality assessment for the before and after studies

Reference, country	Reporting of method for measuring delay	Adjustment for confounding factors	Power calculation	Appropriate statistical analysis
Mitic and Perkins, 1984,[17] Canada	P	N/A	N/NR	Y
Ho *et al*, 1989,[15] USA	P	N/NR	N/NR	Y
Moses *et al*, 1991,[18] USA	P	N/NR	N/NR	N/A
Rustige *et al*, 1992,[19] Germany	Y	N/A	N/NR	N/A
Bett *et al*, 1993,[12] Australia	Y	N/NR	N/NR	N/A
Blohm *et al*, 1994,[13] Sweden	Y	N/NR	N/NR	Y
Gaspoz *et al*, 1996,[14] Switzerland	P	N/NR	N/NR	Y
Maeso-Madronero *et al*, 2000,[16] Germany	N	N/A	N/NR	Y

Y, yes; N, no; P, partial; N/A, not applicable; NR, not reported or insufficient information.

more prolonged campaign was probably required in order for the intervention to be effective.[12 15 18 22] Other factors, such as the frequency and intensity of exposure to the intervention are also likely to be important. Unfortunately, an insufficient number of studies provided information about frequency and intensity of the actual intervention for any conclusions to be drawn. Future studies should measure and report these factors.

Implications for future research

The effectiveness of media/public education campaigns in changing health behaviour is difficult to evaluate. Predictors of delay are complex and are likely to include more than just a good knowledge of the varied symptoms of AMI or a doctor's view of an ''appropriate'' reaction. Many people do not suffer from the well known symptom of chest pain when experiencing an AMI. Hence they may attribute their symptoms to non-cardiac causes, which can increase the delay in accessing medical services.[42] It may therefore be beneficial to use messages that do not include the word ''pain'',[43] emphasise the importance of thrombolytic therapy in preventing death or disability, and make it acceptable for people to access emergency services without fear that they are wasting NHS resources or that their symptoms are not serious enough.[44 45] Factors such as fear of wrongly ascribing symptoms to a heart attack, or fear of being hospitalised may be equally important.[46] It might be useful to gain a better understanding of how patients (and their partners/family) make the decision to call for help before advocating wide scale and expensive educational interventions. It may also be appropriate to target education at high risk groups, including family members. However, there is a need to educate the public at large to call an ambulance if they witness what could be an AMI as informed bystanders have a potentially important role in reducing delay. In addition, it is important to be aware of the impact that any media campaign may have on the number of emergency department visits for chest pain and calls made to emergency services.

Future research requires an appropriate design with baseline measurement of delay time, a reasonable follow up period, and specification of the frequency, intensity and content of the intervention. As the ultimate aim of such interventions is to save lives, mortality should be measured as part of the overall assessment. Our systematic review makes clear the need for such studies before any firm conclusion can be drawn.

ACKNOWLEDGEMENTS

We thank Dr Robert Clark, Dr Gary Latchford, Neil Stanford, Julie Glanville, Dr Jeffrie Strang, Barbara Gurney, Clare Valentine, Geoff Peacock, and Tom Quinn for their comments throughout the review process. We would also like to thank Dr Seokyung Hahn for her advice on reporting of statistics.

CONTRIBUTORS

RL suggested the need for the review. JP obtained the funding. All authors contributed to the execution of the review and content of the paper. AS supervised the review. SD carried out the electronic search strategies. AH, AK, and JP carried out study selection, data extraction and quality assessment, and AS and IW arbitrated when necessary. AS, AH, AK, JP, IW, RL, and DT contributed to the study design, interpretation of the results and critical revisions to the manuscript.

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Funding: this review was funded by a grant from the Research Directorate of the Northern and Yorkshire Regional Office of the NHS.

Competing interests: none declared.

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