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A review of interventions aimed at reducing pre-hospital delay time in acute coronary syndrome: What has worked and why?

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Received 22 December 2010; received in revised form 13 April 2011; accepted 14 April 2011

Abstract

Background: Delay in seeking treatment for acute coronary syndrome (ACS) symptoms is a well recognised problem. While the factors that influence pre-hospital delay have been well researched, to date this information alone has been insufficient in altering delay behaviour.

Aim: This paper reports the results of a critical appraisal of previously tested interventions designed to reduce pre-hospital delay in seeking treatment for ACS symptoms.

Methods: The search was confined to interventions published between 1986 and the present that were written in English and aimed at reducing pre-hospital delay time. The following databases were searched using keywords: Cumulative Index to Nursing and Allied Health Literature (CINAHL), Pubmed, Academic Search Premier, Ovid, Cochrane, British Nursing Index, and Google Scholar. A total of eight intervention studies were identified as relevant. This review was developed following a systematic comparative analysis of those eight studies.

Results: Seven of the eight interventions were based on mass media campaigns. One campaign was targeted at individuals. All were aimed at raising ACS symptom awareness and/or increasing prompt action in the presence of symptoms. Only two studies reported a statistically significant reduction in pre-hospital delay time.

Conclusion: In response to concerns about prolonged pre-hospital delay time in ACS, interventions targeting the problem have been developed. The literature indicates that responses to symptoms depend on a variety of factors. In light of this, interventions should include the scope of factors that can potentially influence pre-hospital delay time and ideally target those who are at greatest risk of an ACS event.

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Keywords: Pre-hospital delay; Acute coronary syndrome; Interventions; Mass media campaigns

1. Introduction

Much of the morbidity and many of the potentially preventable complications associated with coronary heart

disease are linked with pre-hospital delay in seeking treatment for symptoms associated with acute coronary syndrome [1–3]. Timely intervention is critical to the prevention of premature death and disability from myocardial infarction. After the onset of ischemia, myocardial cell death will begin to occur within a finite period, and within hours necrosis becomes evident. Allowing for variations in individuals, complete necrosis of vulnerable myocardial cells takes approximately 2–4 h [4,5]. The restoration of blood flow to an affected artery within half an hour has the

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potential to revoke these events [6–8]. As well as the ischemic effects, fatal arrhythmias, particularly ventricular fibrillation, are complications of acute myocardial infarction (MI), but can be successfully treated with prompt defibrillation and cardiopulmonary resuscitation, as required [9]. Such arrhythmias account for approximately 50% of deaths within the first hour of acute myocardial infarction [10]. Therefore, those who are treated within a short time of symptom onset can derive considerable benefits in terms of reduced morbidity and mortality, as shorter delay times to treatment increase the propensity for preservation of the myocardium and reduce the risk of other complications [11].

There is compelling evidence to support the importance of prompt reperfusion for acute myocardial infarction [12–15]. The advantages of treatments such as primary angioplasty and thrombolysis are inversely related to delay time [16,17]. It has been suggested that for every half hour delay in the administration of thrombolysis or angioplasty, the 1 year mortality rate is increased by 7.5% [15]. The European Society of Cardiology Guidelines has therefore emphasised the importance of keeping total cardiac ischaemic time within a maximum of 2 h and ideally within 1 h for optimum results [18]. While interventions such as thrombolysis and percutaneous coronary angioplasty have enhanced patient outcomes, their full potential has not been maximised, since 30–40% of people delay beyond the timeframe for the most effective delivery of these treatment modalities [19].

The causes of pre-hospital delay are multifaceted, and while no factor in isolation can influence pre-hospital delay time, many researchers have identified contributing factors [20–23]. Although much research has been conducted to identify those factors that influence delay, only a limited number of interventions have been carried out with the aim of reducing pre-hospital delay time. The purpose of this paper is to report the results of a critical appraisal of previously tested interventions designed to reduce pre-hospital delay in seeking treatment for ACS symptoms. The information contained in this paper may, alone or in conjunction with previously published papers on the subject [24,25], assist researchers who are planning to design an intervention to reduce pre-hospital delay time.

The following review questions guided this review:

What are the components of the recent interventions that have been deployed to reduce delay time in seeking treatment for acute coronary syndrome symptoms?

How effective are interventions in reducing delay time?

2. Methods

2.1. Search critique criteria

The critique criteria for this paper were based on the above questions that guided this review in conjunction with the published systematic review by Kainth et al. [25]. A search of published works indexed in Cumulative Index to

Nursing and Allied Health Literature (CINAHL), Science Direct, Cochrane, Pubmed, Academic Search Premier, Ovid, British Nursing Index, and Google Scholar was conducted. The core search terms used were intervention trials and nursing interventions. These terms were combined with the following keywords: acute coronary syndrome, acute myocardial infarction, heart attack and unstable angina, pre-hospital delay, delay to treatment, treatment delay, prolonged delay, decision delay, transport delay, timely treatment, decision and emergency department treatment.

The database search strategy was restricted using inclusion/exclusion criteria. This was with a view to yielding the most relevant articles. Articles published prior to 1986 were not considered eligible, as it was around this time that the emphasis was placed on thrombolysis and, consequently on reducing delay time. To be selected, the articles were written in the English language and reported on an intervention designed to reduce pre-hospital delay in seeking treatment for acute coronary syndrome symptoms. The selected articles measured pre-hospital delay in the event of MI or ACS symptoms. Articles were included if they reported on or reviewed interventions that targeted pre-hospital delay.

3. Search outcomes

A total of 43 citations were considered and their abstracts were read. When study inclusion eligibility was applied, there were eight relevant interventions which met the critique criteria. These were subjected to a comparative analysis (Table 1). Recent reviews of interventions targeting pre-hospital delay time in acute coronary syndrome have contributed to this paper [24,25]. In addition to the seven studies identified by Kainth et al. [25], our search gave rise to one further intervention aimed at reducing pre-hospital delay time.

To address the question: what are the components of the interventions that have been deployed to reduce delay time in seeking treatment for the symptoms of acute coronary syndrome we evaluated the studies' methodological approaches and their quality, using a checklist for assessing study validity [25]. To assess how effective interventions are in reducing delay time, we evaluated outcome measures in addition to the above criteria.

When study inclusion eligibility was ascertained, we carried out a systematic comparative analysis of the eight relevant interventions which met the critique criteria. From this we identified strengths and limitations associated with the various methodological approaches taken to reduce pre-hospital delay time. This contributed towards the advancement of knowledge and provided insights into scientific research requirements for the future, in particular regarding randomised controlled trials.

4. Aims of interventions reviewed

Pre-hospital delay is interpreted as the time taken between initial ACS symptom onset until arrival at the hospital [34]. It

t1.1 Table 1

t1.2 Key points of intervention studies aimed at reducing pre-hospital delay.

t1.3	Study background	Duration	The intervention type and sample size	The message	Results
t1.4	Ho et al. [29] United States in 1986/1987.	2 months.	A 2 month public media education campaign comprising of newspaper inserts, radio and TV announcements. Sample size (N=890).	Symptoms of acute MI and the importance of acting quickly.	Time from onset of chest pain to receipt of definitive care. No significant earlier presentation time noted.
t1.5	Moses et al. [30] United States. Study date not stated.	2 years.	Public education campaign comprising of patient education brochures, TV and radio advertising, public talks and posters Sample size (N=1793).	The warning signs of a heart attack and the need to seek prompt medical attention were disseminated.	Time from onset of symptoms until hospital presentation. No significant earlier presentation time noted.
t1.6	Bett et al. [31] Australia in 1989.	1 week.	An intensive media campaign. Sample size (N=809).	The need to respond urgently to symptoms of suspected MI and the positive benefits of thrombolytic therapy.	Time interval from symptom onset until first seeking help. No significant earlier presentation time noted.
t1.7	Blohm et al. [32]. Sweden in 1986/1987	1 year.	A 3-week intensive media campaign followed by a 9 month maintenance period. Sample size (N=2317).	If pain lasts beyond 15 min, dial immediately for ambulance transport to hospital. It may indicate MI.	Time from onset of symptoms until hospital admission. Median delay time reduced significantly (P<0.001)
t1.8	Study background	Duration	The intervention type and sample size	The message	Delay definition and results
t1.10	Gaspoz et al. [33] Switzerland in 1992.	1 year.	Multi media campaign. Sample size (N=2395).	Information about chest pain, acute MI and thrombolysis was disseminated.	Pre-hospital delay was from onset of symptoms until arrival at the hospital. Median delay time reduced by 25 min during campaign (P<0.002).
t1.11	Meischke et al. [26]. United States in 1991.	2 years.	Mass media intervention. Sample size (N=5444).	Information about acute MI symptoms, the importance of fast action and curability of acute MI. Also, the relevance of the emergency services in diagnosis and treatment.	Defined as time from acute symptom onset to emergency department arrival. No significant earlier presentation time noted.
t1.12	Luepker et al. [28] United States in 1995.	18 months.	Mass media intervention. Sample size control Baseline (N=5051): Intervention Baseline: (N=4582).	Symptom recognition and the need to act fast.	From symptom onset until ED arrival. No significant earlier presentation time noted.
t1.13					
t1.14	Dracup et al. [2] United States/New Zealand in 2002–2004.	2 years.	Individualised educational intervention using a randomised 2 group experimental design. Sample size (N=3522).	Symptom information and emphasis on seeking care fast.	Time from symptom onset to hospital presentation. No significant earlier presentation time noted.

is often divided into phases comprised of decision delay and transportation delay [7]. The combined time from symptom onset until arrival at the emergency department is referred to as total pre-hospital delay. The purpose of all the studies included in this review was to reduce the time from ACS symptom onset until arrival at the hospital: pre-hospital delay time.

5. Population characteristics

Of the eight interventions reviewed, three were randomised controlled trials, whereby individuals [26,27] or communities [28] were randomised to intervention or control groups and cross-compared. The remaining five studies were observational designs [29–33]. The majority of interventions were mass media based, with the target groups for the interventions ranging from whole communities [28–33] to community sub-

elements [26] and individuals [27,28]. In studies that involved individual recruitment [27,28] only those with a history of or risk factors for coronary heart disease were included. In all studies pre-hospital delay time was recorded in different people before and following the intervention. In fact, to date no direct comparisons are available for the same cohort of patients presenting with ACS events before and after an intervention. All campaigns were centred on the need to seek early assistance in the presence of ACS symptoms and some used catch-phrases to augment this message.

6. The campaigns

One of the earliest interventions took place in the United States and was carried out by Ho et al. [29]. This media campaign comprised of newspaper, television and radio

advertising and conveyed a message “Saving time could save your life” which emphasised symptom recognition and appropriate responses to symptoms. Again in the United States, a further mass media intervention was conducted by Moses et al. Patients who presented to an emergency department with at least one acute myocardial infarction symptom were included in this study [30]. This campaign was comprised of public talks along with radio, television and newspaper advertising to educate the public about heart warning signs and the importance of prompt action. Meanwhile, in Australia, the Australian National Heart Foundation campaign was launched in 1989 [31] and this emphasised the benefits of the new and pre-existing therapies for myocardial infarction management. Relevant healthcare providers were educated in addition to the general public.

European studies conducted by Blohm et al. in Sweden [32] and Gaspoz et al. in Switzerland [33] were targeted at the general public and/or high risk individuals. Information on acute myocardial infarction symptoms and early intervention benefits was disseminated. The messages were conveyed through the media in conjunction with leaflet distribution to those admitted to or attending hospital with suspected or known history of acute myocardial infarction.

The first of three randomised controlled trials was conducted by Meischke et al. [26]. It was comprised of a direct mail campaign which was preceded by a brief mass media intervention. The target sample in this study was comprised of individuals over 50 years of age. Individuals were randomised to intervention or control groups. Those assigned to the intervention group received brochures by post which included messages about overcoming fear and denial about myocardial infarction symptoms and the necessity for prompt treatment.

One of the largest community interventions, the REACT trial, was a multi-site study which targeted community groups [28]. Twenty cities in the United States were paired and divided into intervention or control communities. The primary objective was to evaluate the effectiveness of a community intervention in reducing pre-hospital delay.

The cities assigned to the intervention group were targeted with mass media education through community organisations and public, professional and patient education. Direct patient education was further provided for those who attended clinics and had a history of or risk factors for coronary heart disease. The education component of the intervention involved the provision of information regarding myocardial infarction symptoms and the appropriate actions to be taken should symptoms arise.

Dracup et al. targeted individuals who were at high risk of developing ACS symptoms [27]. While those recruited to their study were not necessarily diagnosed with acute coronary syndrome, they were known to have ischaemic heart disease, which rendered them susceptible to the occurrence or recurrence of an ACS event.

The aim of this study was to reduce pre-hospital delay time through the provision of individualised education and to

increase knowledge and improve attitudes and beliefs about seeking care for ACS symptoms. While the control group received the usual advice and care from their healthcare provider, those randomised to the intervention group received an additional one to one 30–40 minute education and counselling intervention. Following the intervention the two matched groups were compared, as data were collected on all patients who subsequently presented to an emergency department with ACS symptoms.

7. Outcome measures

Pre-hospital delay time duration in the presence of ACS symptoms was the primary outcome measurement of all interventions. The majority of studies operationally defined delay as the time from symptom onset until arrival at the emergency department or hospital [27,28,30,32,33]. Other investigators defined it as the time from acute symptom onset until arrival at the emergency department [26,29]. In one study [31] pre-hospital delay time was measured from symptom onset until first seeking help, yet the definition of seeking help was not explicitly stated.

The means of measuring pre-hospital delay time varied across the studies reviewed. With two exceptions [26,27], pre-intervention delay times were measured and reported in the population as a whole. Median pre-intervention delay time between studies ranged from 1 [31] to 3 h [32,33]. Two of the eight studies reported a baseline pre-hospital delay time of less than 2 h [30,31]. As these reported times are already desirable and considerably shorter than those generally identified in the literature [35–39], attempts to improve on them seem ambitious. Baseline delay times in the region of 1 h obviate the need for any additional intervention, as an expectation for improvement would seem unrealistic and unnecessary. Baseline pre-hospital delay times of 3 h were reported by the researchers that observed a reduction in pre-hospital delay time ($p < 0.001$) [32,33]. These delay times are longer than those reported in other studies.

8. Study results

None of the randomised controlled trials reported a significant reduction in pre-hospital delay times between their control and intervention groups. Luepker et al. reported a reduction in total pre-hospital delay time in both groups but no difference between them [28]. Likewise, Dracup et al. reported no time differences between the groups at the end of their study. Meischke et al. collected data from a range of individuals but restricted analyses to those who were white and had private or other medical insurance cover, which limits its application generally. Of the eight studies, only two researchers reported a significant reduction in pre-hospital delay time ($p < 0.001$) [32,33]. These were the two European observational studies. In terms of population, study durations and study variables, these studies were not unlike the other

mass media studies [25]. Yet, the other studies showed no observed reduction in pre-hospital delay time.

However, there is no evidence to suggest that the reported reduction in pre-hospital delay times in these studies was attributable to the employed interventions. The differences may have been attributed to other variables, not measured by the researchers. While the sample sizes were large and the statistical tests used in these studies were appropriate, neither reported that a power calculation was performed or adhered to. Furthermore, delay time data is normally skewed, yet these researchers failed to report whether their data were log-transformed to account for outliers. Neither reported that adjustments were made for confounding variables. Data were collected by designated research nurses in one study [33] but the other [32] did not report that the data collectors were skilled or trained for the purpose. As both studies reported significant reductions in pre-hospital delay, it is not possible to conclude that the method of data collection influenced the outcomes.

9. Delivery of interventions

The predominant form of intervention was mass media public education [26,28–33]. A variety of media methods were used to deliver the campaign messages. These include television and radio broadcasts and advertising on billboard signs, public transport announcements and printed material. The Swedish campaign was the only one not delivered through the medium of television [32]. While Blohm et al. suggest that television is the most effective form of media in Sweden, their study nevertheless reported a significant reduction in pre-hospital delay time ($p < 0.001$) [32]. The television campaign in the Swiss study [33] used the male normative framework in their advertising campaign, with the subject of the campaign being male. The portrayal of a gender-specific message can serve to reinforce the notion that heart disease is a male problem and consequently the campaign may have had little impact on women; indeed the authors reported no significant impact of the campaign on female participants.

Blohm et al. began their campaign with an intensive phase which preceded a prolonged maintenance period [32]. This was also the case for other studies [26,30]. The intervention by Dracup et al. was based on individualised education that aimed to increase knowledge and improve attitudes and beliefs about seeking care for ACS symptoms [27]. The factors that influence responses to symptoms are varied. It is unclear whether campaign intensity or types of medium used are sufficient to bring about the necessary behavioural changes.

10. The campaign messages

In all cases the campaign messages were centred on the necessity for prompt access to care in the presence of ACS symptoms. Some incorporated messages about ACS symptom

recognition and information about the benefits of new and pre-existing therapies for symptom management [26–30]. Some studies either excluded symptom references or placed less emphasis on them [31–33]. While some researchers used catch-phrases to complement their message [26,29,31–33], there were no obvious differences in the types of catchphrases used between the various studies. It appears therefore that slogans and message content did not strongly influence pre-hospital delay times. However, Caldwell and Miaskowski [24] suggest that the content of mass media campaign messages is one variable that could influence behaviour.

The message conveyed by Blohm et al. [32] emphasised the presence of denial associated with ACS symptoms. Some authors suggest that there is a positive correlation between denial and pre-hospital delay [40–42]. Although this relationship has not been well researched or established empirically, emotional responses during an ACS event have been extensively researched. These responses often include symptom denial which can be associated with fear or past experience [40]. However, some authors dispute the association between denial and pre-hospital delay time [43,44]. While the emphasis on denial by Blohm et al. [32] may have been a factor in the observed change in pre-hospital delay time, other studies with similar messages did not report these effects [26–28].

11. Study time frames

Campaign durations varied between studies. The shortest campaign lasted 1 week [31] and the longest was 2 years [26,30]. The successful campaigns were of twelve month duration [32,33]. Blohm et al. suggest that the use of a systematic sustained year of public media information may have been a factor in the success of their study [32]. Otherwise, no study indicated that the campaign duration was a factor in determining observed outcomes.

Some researchers measured pre-hospital delay time during the intervention campaign [28,30,33] while others measured this variable during and immediately following the intervention [26,29,32]. Pre-hospital delay time was measured by Bett et al. only after the campaign or intervention stage had ended [31]. Such variation in data collection times may account for the differences in study outcomes. Blohm et al. [32] extended data collection for 3 years beyond the campaign.

Dracup et al. evaluated the impact of their intervention by measuring the first subsequent post-intervention pre-hospital delay time on those who presented to an emergency department with ACS symptoms [27]. Data were collected for 2 years post recruitment to their study. The study design necessitated this approach as their individualised intervention impact was determined by those subjects who represented to the hospital with ACS symptoms following the education session. The studies that reported reductions in pre-hospital delay time were those that measured this delay time during the intervention and beyond. The medium to long term impact of

the interventions are more easily discerned with on-going follow up. Similarly, restricting the examination of pre-hospital delay time to the precise duration of a campaign precludes the detection of its potential longer-term effects. A lack of good comparison groups in most studies makes it difficult to effectively compare results across studies.

While these before and after studies indicate that media campaigns may reduce pre-hospital delay times, in the absence of corroborating evidence from multiple studies, clear inferences cannot be drawn from them, in terms of their effectiveness. None of the studies included a concurrent observation of two groups of patients who presented with ACS symptoms before and after an intervention, where only one group was exposed to the message.

12. Background information on studies

The studies which demonstrated effectiveness of the intervention in reducing delay times were carried out in Sweden and Switzerland, countries that have universal health insurance schemes and where access to emergency health care is generally good. Conversely, the issue of medical insurance and costs of seeking care are known barriers to health-seeking behaviour in the United States [45]. Five of the eight intervention studies reviewed involved samples from the United States [26–30]. This may account for the differences found between studies within and outside the United States. According to Randolph and Viswanath [46] mass media campaign success is dependent on the nature of the environment and whether that environment facilitates the behavioural change under promotion.

13. Discussion

This paper focused on a review of interventions carried out with the aim of reducing pre-hospital delay time in acute coronary syndrome. The design of the interventions and their impact on reducing pre-hospital delay were appraised under specific criteria. The paper addressed how interventions were designed and delivered. Seven of the eight interventions were mass media campaigns and one study exclusively targeted individuals [27]. There were three randomised controlled trials and five before and after studies.

There is evidence that mass media campaign messages can increase public awareness and, in doing so, can potentially influence how people think and learn [29,47–49]. This is not to suggest that they are effective in altering behaviour. Mass media interventions fail to take cognisance of how people learn or internalise information. While mass media interventions may attempt to account for the ways that people learn and internalise information, their effectiveness may be more dependent on the characteristics of their target population. Those who are exposed to a message need to have an ability to execute the proposed behaviour in order to effect a change. This assumes a level of knowledge, understanding and willingness on the part of the target

group. However, the knowledge-behaviour gap is well-documented [50] and knowledge and understanding do not necessarily alter behaviour. Moses et al. [30] suggest that it is difficult to alter public behaviour on a broad basis, while Ho et al. [29] urge that public education programmes should be of longer duration and repeated at frequent intervals in an attempt to modify human behaviour. Yet, it is difficult to sustain awareness in a campaign as people tend to normalise unpleasant information [40].

The randomised controlled trial is the most reliable guide to providing research evidence about what works in practice [51]. Their application in the form of mass media campaigns is however uncertain. Subjects assigned to control groups can potentially be exposed to some or all of the messages in mass media campaigns and may respond in accordance with these interventions. Consequently, any media exposure may be sufficient to impact on pre-hospital delay time in both groups. The risk of contamination cannot be controlled for and is impossible to measure when media messages are used in individual communities as part of a randomised controlled trial. Therefore, the inclusion of true control groups in mass media evaluations is an important aspect of campaign evaluation [52].

The individualised intervention design offers an alternative to that of mass media designs. To date this approach has not been widely used as an intervention. The provision of individualised education eliminates the concern about non-targeting of high risk individuals, as the sample is based on predetermined inclusion and exclusion criteria. In addition, individualised approaches can be tailored to the person, which favours identification with their personal context. The individualised campaign design provides a forum for the inclusion of family or other relevant individuals. This is significant because evidence indicates that people generally consult with another person before seeking assistance when they develop symptoms of ACS [38].

With so few mass media studies reporting reduced delay time in seeking treatment in ACS, Blohm et al. [53] propose that new media campaigns be established in an effort to alter behaviour associated with delay time in ACS. Caldwell and Miaskowski [24] on the other hand suggest that an individualised approach to teaching symptom evaluation to those at greatest risk might be worth considering. Irrespective of the design chosen, all campaigns will have inherent strengths and weaknesses. The limitations of mass media campaigns may in some way account for the failure to achieve predicted outcomes associated with the reduction of pre-hospital delay time in ACS. Mass media educational interventions have the potential to expose everybody to the same message and thus preclude targeting those at greatest risk of a coronary event. As a consequence, there is no means of determining which individuals internalise the messages conveyed regarding symptom presentation and appropriate actions. In designing such interventions, researchers need to acknowledge these factors before embarking on designing an intervention to reduce pre-hospital delay time.

14. Conclusion

The development of thrombolysis and angioplasty heralded the emphasis of prompt presentation to emergency departments with ACS symptoms. Problems regarding pre-hospital delay have since been identified and interventions developed with a view to addressing this problem. Public education through mass media campaigns have been the predominant choice of intervention. Of the interventions reviewed, three were randomised controlled trials and five were before and after interventions. Evidence for effectiveness in reducing pre-hospital delay time was reported in two studies, neither of which were randomised controlled trials. Those that used media campaigns attempted to expose the public to their message through advertising, written material or public education forums and all stressed the importance of seeking assistance rapidly. The majority of studies also referred to the recognition of heart warning symptoms.

The approaches to study designs and the components of these designs differed among the interventions reviewed here. Such variation in design makes comparisons more difficult as study durations, sampling and outcome measures differed significantly. None of the interventions carried out to date have yielded the predicted positive results. Education through mass media makes it difficult for the public to discern for whom the messages are intended. Furthermore, the risk of intervention contamination between intervention and control groups in randomised controlled trials cannot be controlled for and is not measurable.

Reducing the time to treatment for patients with acute myocardial infarction is a life-saving goal that requires an understanding of the complex issues surrounding the subject. Whether information alone is sufficient to enable patients to make these changes is unclear. From the literature it is evident that responses to symptoms are **dependent** on cognition, emotions and social factors, among other things. Accordingly, messages about symptoms should incorporate comprehensive information about delay. This might include information on denial, coping methods, benefits of seeking assistance and decision making. The message itself and the means by which it is conveyed should therefore be appropriately tailored and targeted at those at greatest risk and at the people on whom they are likely to call when symptoms arise. The development of further interventions to reduce pre-hospital delay must originate from optimum scientific evidence. Accordingly, the findings from this review and the recommendations made by other researchers will promote the development of future studies to save lives through early presentation for ACS symptoms.

References

- [1] Weaver **WD**. Time to thrombolytic treatment: factors affecting delay and their influence on outcome. *J Am Coll Cardiol* 1995;25(Supplement 1): S3–9.

- [2] Newby LK, Rutsch WR, Califf RM, Simoons ML, Aylward PE, Armstrong PW, et al. Time from symptom onset to treatment and outcomes after thrombolytic therapy. *J Am Coll Cardiol* 1996;27: 1646–55.
- [3] Rasmussen CH, Munck AM, Kragstrup JK, Haghefelt TH. Patient delay from onset of chest pain suggesting acute coronary syndrome to hospital admission. *Scand Cardiovasc J* 2003;37:183–6.
- [4] Giugliano RP, Braunwald E. Selecting the best reperfusion strategy in ST-elevation myocardial infarction: it's all a matter of time. *Circulation* 2003;108:2828–30.
- [5] Thygesen K, Alpert JS, White HD. Universal definition of myocardial infarction. *Eur Heart J* 2007;28:2525–38.
- [6] Ruston A, Clayton R, Calnan M. Patients' action during their cardiac event: qualitative study exploring differences and modifiable factors. *BMJ* 1998;316:1060–5.
- [7] Moser DK, Kimble LP, Alberts MJ, Alonzo A, Croft JB, Dracup K, et al. Reducing delay in seeking treatment by patients with acute coronary syndrome and stroke: a scientific statement from the American Heart Association Council on Cardiovascular Nursing and Stroke Council. *Circulation* 2006;114:168–82.
- [8] DeVon HA, Hogan N, Ochs AL, Shapiro M. Time to treatment for acute coronary syndromes: the cost of indecision. *J Cardiovasc Nurs* 2010;25:106–14.
- [9] Finn JC, Jacobs IG, Holman C, Oxer HF. Outcomes of out-of-hospital cardiac arrest patients in Perth, Western Australia, 1996–1999. *Resuscitation* 2001;51:247–55.
- [10] Quinn JR. Delay in seeking care for symptoms of acute myocardial infarction: applying a theoretical model. *Res Nurs Health* 2005;28: 283–94.
- [11] Herlitz J, Thureson M, Svensson L, Lindqvist J, Lindahl B, Zedigh C, et al. Factors of importance for patients' decision time in acute coronary syndrome. *Int J Cardiol* 2010;141:236–42.
- [12] Boersma E, Maas ACP, Deckers JW, Simoons ML. Early thrombolytic treatment in acute myocardial infarction: reappraisal of the golden hour. *Lancet* 1996;348:771–5.
- [13] Boersma E, Mercado N, Poldermans D, Gardien M, Vos J, Simoons ML. Acute myocardial infarction. *Lancet* 2003;361:847–58.
- [14] Nallamothu BK, Bates ER. Percutaneous coronary intervention versus fibrinolytic therapy in acute myocardial infarction: is timing (almost) everything? *Am J Cardiol* 2003;92:824–6.
- [15] De Luca G, Suryapranata H, Ottervanger JP, et al. Time delay to treatment and mortality in primary angioplasty for acute myocardial infarction: every minute of delay counts. *Circulation* 2004;9: 1223–5.
- [16] Gersh BJ, Stone GW, White HD, Holmes Jr DR. Pharmacological facilitation of primary percutaneous coronary intervention for acute myocardial infarction: is the slope of the curve the shape of the future? *JAMA* 2005;293:979–86.
- [17] Alonzo AA. The effect of health care provider consultation on acute coronary syndrome care-seeking delay. *Heart Lung* 2007;36:307–18.
- [18] Antman **EM**. Time is muscle. Translation into practice. *JAMA* 2008;299: T216–21.
- [19] Goldberg RJ, Steg PG, Sadiq I, Granger CB, Jackson EA, Budaj A, et al. Extent of, and factors associated with, delay to hospital presentation in patients with acute coronary disease (the GRACE Registry). *Am J Cardiol* 2002;89:791–6.
- [20] Dracup K, Moser DK. Beyond sociodemographics: factors influencing the decision to seek treatment for symptoms of acute myocardial infarction. *Heart Lung* 1997;26:253–62.
- [21] Fukuoka Y, Dracup K, Ohno M, Kobayashi F, Hirayama H. Symptom severity as a predictor of reported differences of prehospital delay between medical records and structured interviews among patients with AMI. *Eur J Cardiovasc Nurs* 2005;4:171–6.
- [22] Ting HH, Bradley EH, Wang Y, Lichtman JH, Nallamothu BK, Sullivan MD, et al. Factors associated with longer time from symptom onset to hospital presentation for patients with ST-elevation myocardial infarction. *Arch Intern Med* 2008;168:959–68.

- [23] Sheifer SE, Rathore SS, Gersh BJ, Weinfurt KP, Oetgen WJ, Breall JA, et al. Time to presentation with acute myocardial infarction in the elderly: associations with race, sex, and socioeconomic characteristics. *Circulation* 2000;102:1651–6.
- [24] Caldwell MA, Miaskowski C. Mass media interventions to reduce help-seeking delay in people with symptoms of acute myocardial infarction: time for a new approach? *Patient Educ Coun* 2002;1:1–9.
- [25] Kainth A, Hewitt A, Pattenden J, Sowden A, Duffy S, Watt I, et al. Systematic review of interventions to reduce delay in patients with suspected heart attack. *Emerg Med J* 2004;21:506–8.
- [26] Meischke H, Dulberg EM, Schaeffer SS, Henwood DK, Larsen MP, Eisenberg MS. 'Call Fast, Call 911': a direct mail campaign to reduce patient delay in acute myocardial infarction. *Am J Publ Health* 1997;87:1705–9.
- [27] Dracup K, McKinley S, Riegel B, Moser DK, Meischke H, Doering L, et al. A randomized clinical trial to reduce patient pre hospital delay to treatment in acute coronary syndrome. *Circulation* 2009;2:524–32.
- [28] Luepker RV, Raczynski JM, Osganian S, Goldberg RJ, Finnegan JR, Hedges JR, et al. Effect of a community intervention on patient delay and emergency medical service use in acute coronary heart disease: the Rapid Early Action for Coronary Treatment Trial (REACT). *JAMA* 2000;284:60–7.
- [29] Ho MT, Eisenberg MS, Litwin PE, Schaeffer SM, Damon SK. Delay between onset of chest pain and seeking medical care: the effect of public education. *Ann Emerg Med* 1989;18:727–31.
- [30] Moses HW, Engelking N, Taylor GJ, Prabhakar C, Vallala M, Colliver JA, et al. Effect of a two-year public education campaign on reducing response time of patients with symptoms of acute myocardial infarction. *Am J Cardiol* 1991;68:249–51.
- [31] Bett N, Aroney G, Thompson P. Impact of a national educational campaign to reduce patient delay in possible heart attack. *Aust N Z J Med* 1993;23:157–61.
- [32] Blohm M, Hartford M, Karlson BW, Karlsson T, Herlitz J. A media campaign aiming at reducing delay times and increasing the use of ambulance in AMI. *Am J Emerg Med* 1994;12:315–8.
- [33] Gaspoz JM, Unger PF, Urban P, Chevrolet JC, Rutishauser W, Lovis C, et al. Impact of a public campaign on pre-hospital delay in patients reporting chest pain. *Heart* 1996;76:150–5.
- [34] Khraim F, Carey M. Predictors of pre-hospital delay among patients with acute myocardial infarction. *Patient Educ Coun* 2009;75:155–61.
- [35] ISIS-2 Collaboration group. Second International Study of Infarct Survival. Randomised trial of intravenous streptokinase, oral aspirin, both or neither among 17,187 cases of suspected acute myocardial infarction. *Lancet* 1988;8607:349–60.
- [36] ISIS-3 Collaboration group. International Study of Infarct Survival. A randomised comparison of streptokinase and of tissue plasminogen activator vs. anistreplase and of aspirin plus heparin vs. aspirin alone among 41,299 cases of suspected acute myocardial infarction. *Lancet* 1993;339:753–70.
- [37] Dracup K, Moser DK, McKinley S, Ball C, Yamasaki K, Kim CJ, et al. An international perspective on the time to treatment for acute myocardial infarction. *J Nurs Scholarch* 2003;35:317–23.
- [38] McKinley S, Dracup K, Moser DK, Ball C, Yamasaki K, Kim CJ, et al. International comparison of factors associated with delay in presentation for AMI treatment. *Eur J Cardiovasc Nurs* 2004;3:225–30.
- [39] Goldberg RJ, Spencer FA, Fox KAA, Brieger D, Steg PG, Gurfinkel E, et al. Pre-hospital delay in patients with acute coronary syndromes (from the Global Registry of Acute Coronary Events). *Am J Cardiol* 2009;103:598–603.
- [40] Alonzo A, Reynolds N. Responding to symptoms and signs of acute myocardial infarction—how do you educate the public? A social-psychologic approach to intervention. *Heart Lung* 1997;26:263–72.
- [41] Dracup K, Moser DK, Eisenberg M, Meischke H, Alonzo A, Braslow A. Causes of delay in seeking treatment for heart attack symptoms. *Soc Sci Med* 1995;40:379–92.
- [42] Perkins-Porras L, Whitehead DL, Strike PC, Steptoe A. Causal beliefs, cardiac denial and pre-hospital delays following the onset of acute coronary syndromes. *J Behav Med* 2008;31:498–505.
- [43] Kenyon LW, Ketterer MW, Gheorghade M, Goldstein S. Psychological factors related to prehospital delay during acute myocardial infarction. *Circulation* 1991;84:1969–76.
- [44] Theisen ME, MacNeill SE, Lumley MA, Ketterer MW, Goldberg AD, Borzak S. Psychosocial factors related to unrecognized acute myocardial infarction. *Am J Cardiol* 1995;75:1214–9.
- [45] Smolderen KG, Spertus JA, Nallamothu BK, Krumholz HM, Tang F, Ross JS, et al. Health care insurance, financial concerns in accessing care, and delays to hospital presentation in acute myocardial infarction. *JAMA* 2010;303:1392–400.
- [46] Randolph W, Viswanath K. Lessons learned from public health mass media campaigns: marketing health in a crowded media world. *Annu Rev Public Health* 2004;25:419–37.
- [47] Eppler E, Eisenberg MS, Schaeffer S, Meischke H, Larson MP. 911 and emergency department use for chest pain: results of a media campaign. *Ann Emerg Med* 1994;24:202–8.
- [48] Goldberg RJ, Gurwitz J, Yarzebski J, Landon J, Gore JM, Alpert JS, et al. Patient delay and receipt of thrombolytic therapy among patients with acute myocardial infarction from a community-wide perspective. *Am J Cardiol* 1992;70:421–5.
- [49] Buckley T, McKinley S, Gallagher R, Dracup K, Moser DK, Aitken LM. The effect of education and counselling on knowledge, attitudes and beliefs about responses to acute myocardial infarction symptoms. *Eur J Cardiovasc Nurs* 2007;2:105–11.
- [50] Valente TW, Paredes P, Poppe PR. Matching the message to the process the relative ordering of knowledge, attitudes, and practices in behavior change research. *Hum Commun Res* 2006;24:366–85.
- [51] Torgerson D, Torgerson C. Designing randomised trials in health, education and social sciences. Hampshire: Palgrave Macmillan; 2008.
- [52] Brown JD, Bauman KE, Padgett CA. A validity problem in measuring exposure to mass media campaigns. *Health Educ Behav* 1990;17:299–306.
- [53] Blohm M, Hartford M, Karlson BW, Luepker RV, Herlitz J. An evaluation of the results of media and educational campaigns designed to shorten the time taken by patients with acute myocardial infarction to decide to go to hospital. *Heart* 1996;76:430–4.