



Original article

Barriers to the implementation of prehospital thrombolysis in the treatment of ST-segment elevation myocardial infarction in South Africa: An exploratory inquiry



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ABSTRACT

Introduction: Evidence-based guidelines advocate percutaneous coronary intervention (PCI) as the mainstay reperfusion strategy for ST-segment elevation myocardial infarction (STEMI). However, the South African health system is not well positioned to provide PCI as a ‘mainstay strategy’. In response, the Health Professions Council of South Africa approved the use of prehospital thrombolysis (PHT) for emergency care practitioners in 2009. However, since its approval, prehospital thrombolysis has failed to reach a level of systematic uptake indicative of successful implementation. The current study aimed to explore, through a qualitative inquiry, barriers to PHT for the treatment of myocardial infarction within a South African context.

Methods: A qualitative single-case study design was used where a series of semi-structured interviews were conducted involving purposefully selected participants. The case comprised a nationalised private emergency medical service, and participants were selected in view of relevant experience and knowledge. Requisite data was conceptualised through the consolidated framework for implementation research, and thematic analysis outlined the data coding procedures of the study.

Results: The study identified potential barriers to the implementation of PHT. These comprised cost, logistics, inter-professional collaboration, leadership engagement, and beliefs or scepticism associated with PHT.

Conclusion: A lack of strategic implementation has resulted in a poor introduction of evidenced-based pre-hospital cardiac care, affecting vulnerable populations who may have otherwise benefited from receiving this level of care. Given the time-sensitive nature of STEMI management, and severely limited access to ‘primary reperfusion’, PHT resembles not only a logical but also appealing solution in the South African context.

African relevance

- Africa faces a shortage of PCI facilities and yet, Prehospital thrombolysis (PHT) remains non-existent
- It is believed that this is primarily due to the lack of African pre-hospital emergency care systems
- PHT is justifiably a logical solution in the under-resourced African setting

Introduction

Percutaneous coronary intervention (PCI) remains the reperfusion strategy of choice in STEMI within an optimal time frame of 90 min from first medical contact [1]. PCI represents a specialised practice, requiring highly trained, experienced medical staff and advanced

technical equipment. In developed countries, PCI represents best practice for STEMI, with international consensus denoting it as the gold standard reperfusion strategy [2]. Despite advancements in healthcare infrastructure, resources in relation to PCI are lacking in South Africa [3], posing concerns for the healthcare profile of the country [4].

Thrombolysis, specifically prehospital thrombolysis (PHT), is a well-established therapy, which provides an alternative reperfusion strategy to PCI [5], with well-documented safety and effectiveness [6]. Importantly, PHT was introduced to reduce time to reperfusion further [7,8], and as supported by a recent Cochrane review [9], and can be safely performed in the prehospital arena [10]. Therefore, PHT represents a valid and logical solution within contexts where primary reperfusion strategies are lacking, such as South Africa.

South African prehospital emergency care has made significant advances, and is now able to offer better delivery and quality of care

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through extended prehospital capabilities [11]. The advent of the emergency care practitioner (ECP) registered with the Health Professions Council of South Africa (HPCSA) has seen skills added into pre-hospital care. These comprise advanced airway procedures incorporating the use of neuromuscular blockers, i.e. rapid sequence induction (RSI) and clinical reperfusion therapy in the form of PHT.

While RSI appears fully implemented, PHT has rarely – if ever – been provided with few or no documented cases pertaining to its use as a definitive treatment strategy, despite evidence advocating its value [12–14]. The current study aimed to identify barriers to the implementation of PHT in the hope of understanding why PHT, as an evidence-based practice for STEMI, has not been fully implemented within South Africa.

Methods

A qualitative case study design was used and a single South African private emergency medical service (EMS) with a national footprint was conceptualised as the case. For demographic purposes, provincial EMS data was considered and supported by regional STEMI statistics, although participation was declined by respective EMS authorities. The private healthcare sector represents approximately 17% of the population [15], not guaranteeing a wide demographic; however, a nationalised service, contrast to provincial EMS which is regionalised, creates the capacity for uniform data. Furthermore, it is recognised that the South African private healthcare sector often acts as a catalyst in facilitating change, with the private EMS being the first to initiate prehospital RSI [16]; thus, the selection of a private EMS was deemed appropriate for the study.

In compliance with the Protection of Personal Information (POPI) Act (No. 4 of 2013), a formal request for data collection was submitted to the EMS organisation. Once potential participants had been identified, permission to access individuals was sought from the EMS organisation.

Additionally, participant information was sourced through snowball sampling, enabling access to contacts who may not have been known to the researchers. Participants were initially contacted telephonically, allowing for informal introductions, after which they were emailed formally with a follow-up briefing and full information letter.

Seven semi-structured interviews were conducted in August–September 2017 with operational ECPs, managers, clinical governance personnel and educational staff related to the selected private EMS. Data saturation was reached after five interviews and two more interviews were conducted to verify this. One person declined to be interviewed. The researchers aimed to include a heterogeneous mix of informed perspectives believing this would provide rich data in relation to the research aim. Participant accounts revealed a wide array of clinical experience, ranging from < 6 months to > 20 years in the EMS.

Table 1
Qualitative themes for the implementation of PHT guided by the CFIR.

Themes	Sub-themes	Key discussion points draws from data
Theme 1 Interventional characteristics	Cost	<ul style="list-style-type: none"> Supportive equipment and the diffusion of responsibility Pharmaceutical disbursements Medical coding and billing procedures
Theme 2 Outer organisational setting	Complexity	<ul style="list-style-type: none"> Logistical factors and the process of innovation
Theme 3 Inner organisational setting	Cosmopolitanism	<ul style="list-style-type: none"> Healthcare divides and inter-professional collaboration A continuum of care and prerequisite for thrombolysis
	Readiness for implementation	<ul style="list-style-type: none"> Healthcare system inadequacies Adoptive behaviour versus status quo Task difficulty and level of enthusiasm
	Implementation climate	<ul style="list-style-type: none"> Leadership influence and initiative
	Leadership engagement	<ul style="list-style-type: none"> Perceptions of the requirement of thrombolysis
Theme 4 Characteristics of individuals	Knowledge and beliefs about the intervention	<ul style="list-style-type: none"> Scepticism and associated risk perceptions Confidence and competency
	Self-efficacy	<ul style="list-style-type: none"> Education and training

All interviews were conducted in English. The first author conducted all seven interviews and was responsible for coordinating the meeting times. The interviews were conducted in a venue selected by the participants and were audio recorded and transcribed verbatim. Interviews comprised of both open and closed-ended questions which were supplemented by follow up or prompting techniques. Interview questions were predicated on participants cognisance of PHT, including effectiveness, safety and necessity. The focus of inquiry related to factors involved in the implementation process with participants explaining reasons as to why they felt PHT had not been successfully implemented in the South African context. The consolidation framework for implementation research (CFIR) was used to guide the data collection and data analysis. Thematic analysis was used to analyse the data with a subsequent code-recode procedure as well as negative case analysis used to determine consistency within the data. The study was funded by the primary author and supplemented by a research grant from the Durban University of Technology. Results were reported in compliance with the standards for reporting qualitative research (SRQR).

Credibility was enhanced by the incorporation of a structured pilot study, which comprised 4 ‘mock’ interviews, and enabled objective as well as relevant feedback from experienced pre-hospital practitioners. It was noted that an understanding of the real and perceived barriers to PHT was at the basis of this research and the pilot study resulted in minor adjustments which improved the flow of interview questioning. Dependability was ensured using a manual scribing technique for code generation, and a thematic analysis method within the reviewing process facilitated a code–recode procedure, during which codes were analysed, checked and reanalysed. A mix of informed perspectives from various organisational structures and levels of clinical experience constituted a source triangulation method to improve trustworthiness. There were no further amendments to the transcripts following the member checking process. Sufficient background to the study context and methods enhanced transferability of the study.

Approval for the study was granted by the Durban University of Technology Institutional Research Ethics Committee (IREC 64/16), and gatekeeper permission was provided by the selected private EMS. Participation was voluntary with informed consent granted before commencing the interviews and participants could withdraw at any time. Only the researchers had access to the data which was stored in a password protected file in a password protected computer.

Results and discussion

The data analysis yielded four overarching themes, eight subsequent themes, and fourteen discussion points as illustrated in Table 1. Accordingly, the discussion involved supportive equipment, logistical factors, healthcare collaboration, healthcare system inadequacies, adoptive behaviour, leadership influence and scepticism towards the

routine use of PHT.

Reliable and relevant equipment remains an integral component of healthcare practice, and one example mentioned within the study was the 12-lead electrocardiogram (ECG). An ECG machine represents a significant cost burden for EMS organisations in South Africa with a price range of between R120 000 and R500 000 at the time of this research. It was considered that, at the time, not all components of South African EMSs were capable of such provisions, limiting the diffusion of innovation or, in this instance, the degree to which PHT could be more broadly implemented.

In addition, pharmaceutical disbursements, including direct and indirect costs of thrombolytic drugs, are considered one of the main reasons why thrombolysis is lacking in developing countries [17]. Pharmaceutical disbursements are, however, also considered paradoxical, as costs are typically offset through economised resources and improved clinical outcomes, which require minimal hospitalisation [18]. Moreover, it could be argued that PHT is cost neutral when drug administration costs are considered in isolation.

One of the reasons cited by participants for non-delivery of PHT is that, at the time of this research, there was no medical code for the procedure in the prehospital setting (at the time of writing, there still is no such code). This prevented the participating EMS from seeking reimbursement as medical coding represented a healthcare practice, which translated the utilisation of equipment or drugs into financial codes for billing purposes. This is because, historically, medical coding systems in South Africa were designed for general physician practices [19].

Logistical issues were cited as another reason for the lack of PHT, such as storage, allocation and clinical oversight regarding the independent administration of thrombolytic drugs. When conceptualising logistical factors, the type of innovation is key, as this determines the complexity of the innovation process and, ultimately, whether the advantages of the intervention outweigh the efforts required to implement it [20].

An organised multidisciplinary approach and continuum of care are essential components of STEMI management and, by extension, PHT, which reduces risks and improves patient outcome [21]. The key to a continuum of care lies in both inter-professional collaboration and the combined effort of multiple healthcare professionals, which in turn have an influence on the effectiveness of healthcare interventions. However, 'operational gaps' exist, and a multidisciplinary approach to the continuum of care between EMS and hospitals remains a major challenge in South Africa [22].

Moreover, PHT ideally requires the support of cardiologists, with participants citing the lack of these specialists as a barrier to PHT. At the time of this research, there were approximately 175 registered cardiologists in South Africa [23], which equated to approximately one cardiologist for every 326,000 patients. Conceivably, this constitutes a barrier as cardiologists function as specialists, whose role is crucial in the diagnosis and treatment of cardiac conditions, including STEMI. However, despite perceivable disadvantages, a shortage of cardiologists does not explain why specialists should be the first point of contact for STEMI diagnosis or management – especially as within South African emergency departments, non-cardiologists are currently performing thrombolysis. Furthermore, cardiac telemetry can support 12-lead ECG transmission to any location nationally or internationally [24]. It can also be argued that ECPs can decide independently to administer a thrombolytic agent without recourse to an online or telephonic resource to support clinical decision-making. Numerous examples exist where paramedics are 'independently' administering thrombolytic agents often supported by thrombolytic or fibrinolytic checklists. Castle et al. [25] reviewed the UK prehospital thrombolysis 'checklist' which identified 25% of patients with STEMI met entry criteria. It is noteworthy that the UK checklist was risk adverse and did not exclude these patients from receiving in-hospital thrombolysis. On reflection, the lack of supportive structures, i.e. specialists, is arguably an indication of a

perceived barrier rather than a barrier to PHT.

Adoptive behaviour resembles organisational commitment to innovations in contrast to existing practices and potentiates barriers to change, since organisations typically rely on status quo practices to succeed [26]. In this regard, participants cited the protocol: morphine, oxygen, nitrates, aspirin (MONA), a status quo practice in South Africa. This demonstrates a 'recipe' for STEMI management, which does not align with current evidence. Fundamentally, only aspirin is known to improve patient outcomes, whereas the routine administration of oxygen is no longer a recommended STEMI treatment [27,28].

Enthusiasm for practice change is relative to successful implementation [29]; however, participants' responses revealed diminished enthusiasm towards PHT. This was expressed through concerns of task difficulty and decision-making skills in relation to PHT administration. However, no evidence suggests that PHT or the decision-making process associated with it is more complex than RSI, which, as a procedural skill, was successfully implemented. The conception in this regard is that RSI replaced an already imbedded skill, i.e. drug facilitation intubation; hence, maintaining a natural level of enthusiasm for its implementation. It is also worth noting that on a fundamental level, implementation is innovation-exclusive, implying that the receptiveness of the climate within an organisation towards certain innovations, in contrast to others, can influence uptake [30]. Within organisational settings, leadership also has a profound influence on the capacity to foster practice change [31], with some participants expressing perceptions of limited leadership engagement regarding PHT. While the concept of leadership initiative was not directly observed in the current study, a lack of leadership engagement – and even perceptions of it – could potentiate barriers to the implementation of PHT (Table 2).

Knowledge and beliefs about an intervention play a crucial role in implementation, especially among those responsible for promoting change or development. Strong opinions about an intervention, despite factual accuracy, could potentially shift cultural understanding within an organisational setting and, in turn, create barriers to change. One of the considerations emergent in the current study was whether PHT was a requirement in 'urban' settings, in contrast to 'non-urban' areas. This belief is based on the notion that, since urban areas are industrialised, they can maintain and support PCI; therefore, limiting the viability of alternative reperfusion strategies, such as PHT. The argument that PHT is a non-requirement in urban settings hinges on the actual number of PCI-capable facilities (urban or otherwise) and their geographical location. At the time of this research, there were 62 PCI-capable facilities in South Africa, with nearly half located in only one major region in the country, and 75% of which are in the private healthcare sector limiting access [3]. It is also worth noting that the terms 'urban' and 'non-urban' in South Africa are now somewhat fluid since this is more indicative of an integrative society [32]. The key issue when contextualising PHT, however, is time to reperfusion, and in a South African study, the mean time to definitive STEMI treatment from symptom onset, was 8.36 h in Durban and surrounding areas [33]. In contrast, Maharaj et al. [34] found a median door-to-needle time of 54 min (range 13–553) in three Cape Town emergency centres.

If we consider the landmark paper by Boersma et al. [35] which clearly demonstrates the time-sensitive nature of thrombolytic therapy as well as the Cochrane review by McCaul et al. [9], we argue that the reported time to thrombolysis, within both Durban and Cape Town, represents a sub-optimal reperfusion strategy. Given that patients who receive PHT within 2 h of symptom onset have a lower mortality than those who receive primary angioplasty [36], PHT, even within the urban setting, remains a logical and evidenced-based solution for timely STEMI management in South Africa.

The notion of PHT, however, is typically surrounded by controversy [14], and was reflected in participant responses within the study. However, evidence suggests that when administered by trained pre-hospital practitioners, PHT is safe and economically viable [12]. Moreover, risk perceptions exist within the realm of both in-hospital as

Table 2
Qualitative responses reflecting barriers for the implementation of PHT.

Quotations from research participants (please note that all responses are reproduced verbatim and unedited)
<p>1.1 Supportive equipment and the diffusion of responsibility</p> <p><i>If we start talking about provision of care, who's going to be able to do it? So, it will only be one or two components of the healthcare system that's going to be able to do prehospital thrombolytics? [...] It's a huge capital outlay to actually get that equipment in place, and, if you look at the provincial sectors, and not in any specific provincial [service], or any specific province, you'll see that the level of equipment on the ambulances won't allow you to do a 12-lead ECG, so they can't employ thrombolytics, so there's several barriers that lie there.</i></p> <p>1.2. Pharmaceutical disbursements</p> <p><i>Prehospital thrombolysis, all I know is that it's very expensive, and I think that is one of the biggest issues why thrombolytics is not used. [...] We're not issued with that drugs, and I think it's due to financial, I think it's mostly financial, first of all the reasons that we don't carry that drugs.</i></p> <p>1.3. Medical coding and billing procedures</p> <p><i>They are going to have to empower the providers to actually bill for what they are doing, because if there's no code to bill for something, then the medical aid, well, you can't bill for it, so they need to create codes.</i></p> <p>1.4. Logistical factors and the process of innovation</p> <p><i>I mean, how is this governed? Is it independently practice-driven? Is it medical officer-driven? What's the procedures for giving it? And, all of these things complicate its use actually.</i></p> <p>2.1. Healthcare divides and interprofessional collaboration</p> <p><i>We have tried, and I wouldn't say failed, but we have not succeeded in setting up a cardiac network to the extent of actually getting cardiologists involved in the prehospital decision, because from a governance point of view, it's important that a patient, a decision be made for a patient at point A, follows through to point B, C and D.</i></p> <p>2.2. A continuum of care and prerequisite for thrombolysis</p> <p><i>You see, and that's the biggest thing with, within EMS, I'm talking EMS prehospitally, we do things in isolation, you know, prehospital care has to match in-hospital capacity and capability, there's no point in us dreaming up things in the prehospital system, that get blocked, or aren't available in an in-hospital system</i></p> <p>3.1. Healthcare system inadequacies</p> <p><i>We don't have a cardiologist who is available to be a reference point for practitioners to engage with. I think there's, like, less than sixty cardiologists, like this tiny number of specialists, cardiologists in the country. So how does that work? You're not going to have a cardiologist at every hospital.</i></p> <p>3.2. Adoptive behaviour versus status quo</p> <p><i>[P]ossibly fear and a lack of knowledge would be your biggest thing, and a lack of emphasis on prehospital thrombolysis. We're taught MONA until it comes out of our ears.</i></p> <p>3.3. Leadership influence and initiative</p> <p><i>[W]e cannot, people on the road, in Ops [operations] or whatever, they cannot drive this initiative if the people on the top are not fully involved in this.</i></p> <p>4.1. Perception of the requirement of thrombolysis</p>

Table 2 (continued)

Quotations from research participants (please note that all responses are reproduced verbatim and unedited)
<p><i>I don't think there is a strong need for prehospital thrombolysis, especially if the hospitals are so nearby and if you can start treatment, working through your MONA protocol, and then initiate that, and then alert the hospital, or, and the Cath Lab [Cardiac Catheterisation Laboratory] en route, and then they can have everything ready.</i></p> <p>4.2. Scepticism and associated risk perceptions</p> <p><i>I think there's the whole bleeding risk and, if something goes wrong, it has the potential to go seriously wrong.</i></p> <p>4.3. Confidence and competency</p> <p><i>I'm not currently confident that I can perform a thrombolytic case one hundred per cent correctly okay, and I've been qualified as an ECP for seven, no, eight years. [...] I don't even know if it's confidence, I can be a hundred per cent confident but if I'm competent is another question, and I base that on skill decay. I don't use, I haven't used it. I haven't done it</i></p>

well as out-of-hospital thrombolysis with no evidence that PHT increases the rate of complications, in contrast to in-hospital thrombolysis [37]. The risk of bleeding was one of the reasons cited as scepticism towards PHT. However, apart from myocardial rupture which may increase with treatment delay although Becker et al. [38] dispute this risk, all complications associated with thrombolysis remain static regardless of drug administration location whereas the benefits of thrombolytic therapy are time-sensitive [2].

Apprehensions around self-efficacy in relation to confidence and/or competence based on training and current clinical exposure regarding the use of PHT emerged during the study. Knowledge and learned experiences are essential elements of clinical practice, although a lack of practical application or extended periods of non-compliance in terms of learnt skills results in skill decay [39]. Referring to a deterioration in proficiency, skill decay results from a lack of practice over time, denoting an inferior ability to perform skills due to retention intervals [40].

While there is a paucity of research on advanced life support practitioners' skill retention, evidence suggests that skill decay is likely to occur within six to 12 months after initial training [41]. Concerns from participants in this regard highlight the lack of exposure to PHT, in turn, creating barriers that have to be overcome before fully implementing PHT or at least, before scaling up the application of PHT.

A limitation of this study was that it was only conducted in a single national private EMS service. However, this research presents an opportunity to raise the question as to why RSI was so readily accepted within the prehospital field in comparison to PHT. This is an area of research that warrants further study and highlights the significance of implementation science which aims to explore the systematic uptake of evidence-based practices in public health settings.

Recommendations

The following strategies were concluded in order to overcome identified barriers to PHT, and were guided by the expert recommendations for implementing change (ERIC) strategy tool.

- Stage implementation scale-up through deliberate efforts and strategic planning, and link these to clinical oversight, monitoring and evaluation systems.

- Promote collaboration through network weaving based on shared goals and outcomes of healthcare services or organisations, and align these to create PHT viability.
- Conduct internal readiness assessment based on organisational structures in order to improve systematic uptake; thereafter, empower agents of change to promote uptake.
- Obtain formal leadership commitments regarding preliminary strategies that are rooted in abstract theories for PHT, i.e. Grampian region early anistreplase trial (GREAT) [42].
- Provide expert consultation and make training dynamic by fostering partnerships with clinical facilities who engage routinely with thrombolysis, i.e. coronary care units.

Conclusion

The 1996 South African Constitution guarantees healthcare as a socioeconomic right, and stipulates that no one may be refused appropriate treatment in a true emergency. Timely intervention in STEMI is crucial, with treatment strategies and minutes determining survival outcome. As a result, Goldstein and Wiel [43] correctly assert that STEMI represents the prototype of a true emergency. With a time-sensitive clinical approach to STEMI, and severely limited access to primary reperfusion, PHT resembles not only a logical but also appealing solution in the South African context.

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Dissemination of results

Results of the study were disseminated to the Emergency Medical Service which participated in this study.

Author contributions

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: AL contributed 50%; SS 35% and NC contributed 15%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declared no conflicts of interest.

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