

Title:

Treating Sepsis with Intravenous Antibiotics in the Emergency, Prehospital Setting: The Role of Paramedicine, a Qualitative Study.

Authors:

Lead Author: Patryk Jadzinski, ^{MRes} & Co-Author: Chris Markham, ^{PhD}

Abstract:

Background: The effectiveness of the use of intravenous (IV) antibiotics for treatment of sepsis in the United Kingdom, in the prehospital emergency care, is not fully understood. Equally, the views of the key clinical decision makers in ambulance services, associated with this type of treatment, have not been documented to this date.

Aims:

To provide the contemporary, primary data on the views and opinions of Medical Directors from across the UK, on the use of IV antibiotics for treatment of sepsis in prehospital emergency care.

Methods:

This study used a qualitative methodology, in order to develop new knowledge. Semi-structured telephone interviews were carried out, where participants were encouraged to share their personal and professional views on the use of the IV antibiotic intervention, to treat sepsis within the ambulance service. The interviews were recorded, transcribed and a thematic content analysis with the principles of grounded theory was carried out.

Findings:

Analysis of the data, identified five themes related to the views of Medical Directors, on the use of IV antibiotics for sepsis in emergency, prehospital care. These themes were labelled: *Barriers and Enablers*, *Early Sepsis Recognition*, *Accurate and Consistent NEWS scoring*, *The Need for Primary Evidence and Standardisation of the Equipment and Protocols*. A range of opinions was identified, with the emphasis on rapid transfers and the need for further evidence.

Conclusion:

There are encouraging results, indicating that there is a drive for early sepsis diagnosis and pre-alerting to the appropriate receiving unit. However, there are some potential barriers to standardising the approach, if it was proposed for paramedics to collect blood samples and administer IV antibiotics. Additionally, in the absence of UK data on the effectiveness of this treatment, many key decision makers are reluctant to consider this practice, as a standard approach. At the same time, there are some strong opinions about using the already available Benzylpenicillin, for the treatment of suspected sepsis.

Key Words

Sepsis, Prehospital Antibiotics, Paramedic, Medical Directors, Ambulance

Key Points

- The importance of systematic use of the National Early Warning Score by all healthcare professionals, when treating septic patients has been emphasised.
- This study has identified a number of barriers and enablers to the delivery of prehospital antibiotics, for treatment of sepsis in the UK ambulance service.
- Collecting blood samples by the ambulance service could be challenging, due to a varying range of equipment being used by different microbiology departments.
- Limited access to patient care records by the ambulance crews, could risk inappropriate antibiotics being administered.
- Currently there is limited understanding of the efficacy of the UK emergency, prehospital administration of antibiotics in sepsis.

Introduction:

Sepsis is a critical complication of an infection, which if left untreated, can lead to death. In an advanced stage, as a result of the organism's response to an infection, it damages tissues and organs in the body. In further stages, sepsis can lead to septic shock, subsequently, deteriorating into a multiple organ failure (The UK Sepsis Trust 2016), (Qureshi and Rajah 2008). In the UK, sepsis has a mortality rate 40%, contributing to an annual mortality of 44 000 individuals. This figure represents more deaths than patients with bowel, prostate and breast cancer combined (The UK Sepsis Trust, 2016). This percentage has been shown to be halved, if the appropriate care bundle, referred to as "Sepsis Six", is delivered within one hour of recognising severe sepsis (Steinmo et al. 2016).

The National Institute for Health and Care Excellence (NICE), confirms that broad spectrum antibiotics should be administered within one hour of identifying that the patient meets the high risk criteria (NICE 2016, 1.6.1). It is further suggested by Chamberlain (2009), that pre-hospital delivery of antibiotics results in shortened Intensive Care Unit stay and also decreased mortality rates. Further to this, Daniels, Nutbeam & Keep (2015) argue that in the areas where the ambulance conveyance time exceeds one hour, it is logical that recognising and treating sepsis, in the prehospital setting, will save more lives than simply alerting the hospital and undertaking a time critical transfer. Kumar et al. (2006) highlights the impact of the delay in antibiotic administration and report that in the advanced stages of sepsis, each hour of delay in antimicrobial administration can be associated with an average increase in mortality of 7.6%. Paramedics are often the first to recognise and intervene with sepsis in the community (Sepsis Trust UK & College of Paramedics 2014), yet currently, there is limited evidence base and prehospital treatment available for the UK population being treated by paramedics.

However, Pike et al. (2015) carried out a study, involving paramedics collecting blood cultures, recognising sepsis in two specific patient groups and administering IV antibiotics in the prehospital setting. Their work evidenced that paramedics could successfully diagnose and treat sepsis. Indeed,

93% of cases were confirmed by in-hospital medical consultants, concluding that paramedics were capable of delivering the required care to sepsis patients in a timely manner. This is arguably, the most promising study, because it provides evidence that paramedics are capable to be further involved in prehospital treatment of sepsis.

Indeed, a comprehensive literature review, suggests that there are no UK studies that investigate either the effectiveness of IV antibiotics in the treatment of prehospital sepsis, or publications related to the policy of the ambulance services, associated with this form of sepsis treatment. The search terms and databases chosen are illustrated in appendix A. It could be speculated, whether these paramedics would be in a position to reduce the number of deaths, by treating sepsis earlier.

Aim and objectives:

The aim of this study was to illuminate the views of Medical Directors, representing UK, National Health Service (NHS) Ambulance Services, associated with the use of intravenous antibiotics, in order to treat prehospital sepsis. This aim was achieved by conducting semi-structured interviews, which then were transcribed and thematically analysed, in order to produce the themes that arise from the data collected.

Methods:

Design

The study is designed according to the principles of Glaser and Strauss (1967) Grounded Theory. Qualitative research focuses on the beliefs, experiences and interpretations of participants, which was a crucial design element in this study's aim, to reveal the perceptions of participants themselves. It does this, by encouraging participants to use the richness of their own words, to explore and describe their experiences in relation to the research question. This approach involves a cyclical process of

collecting data, analysis, developing a coding scheme, followed by further analysis and investigating the emerging theory, until a point of saturation is reached, where no new constructs are emerging (Green and Thorogood 2018). An interpretivist framework, also known as the constructivist perspective was followed, where the researcher believes that there is no singular, objective reality and every individual perceives the world, or in this case an intervention, based on their personal experiences (Bergin 2018, p. 18). This approach is most suited for the nature of this study, where the researchers aim to illuminate personal views and beliefs of the participants.

Semi-structured telephone interviews were completed, in order to collect the data. Semi-structured interviews feature a list of questions to be covered, but allow the facilitator to explore the topics in greater depth (Bergin 2018, p. 132). The qualitative design of the study was deemed most appropriate, in order to provide a meaningful and rich description of the views of the ambulance service Medical Directors, in relation to the use of prehospital, intravenous antibiotics, in order to treat prehospital sepsis.

Ethical Approval

This study has received a favourable opinion from the University of Portsmouth Science Ethics Committee, ref: SFEC 2018-055.

Sample

A purposive sampling strategy was used, which is recognised as a non-probability sampling method, where participants are selected by the judgement of the researcher (Dudovskiy 2018). This method was used, as the researcher was interested in the views of experts, and lead decision makers for the organisation. The inclusion criteria were purposely narrow, as because of their position, the participants targeted, were the only appropriate representatives of the organisations, who were able to provide answers to the questions asked.

Recruitment

Medical Directors from all 14 United Kingdom NHS ambulance services were approached to participate in the study. Following informed consent, telephone interviews were scheduled.

Setting

All interviews were completed over the telephone, at a time and venue suitable for participants, usually their workplace. These arrangements were accommodated, so the participants could choose the most appropriate time and place to take the call, and where they could feel free to express their opinion in strict confidentiality.

Positionality

Positionality is a concern in qualitative research, in relation to methods of collecting data. Davies (2018) questions how does the position of a researcher, influence the way they interpret and interrogate the findings. The CI, disclosed their role as a paramedic and lecturer to the participants and although is involved in current practices in Paramedicine, a conscious effort was made, to bracket any pre-conceptions related to the research question that the CI may have had. Data was collected and analysed through the process of reflexivity, where as described by Mills et al. (2010), the researcher continuously critically reflects on their own biases and assumptions throughout the research process and how these influence on the overall study.

Data collection

All telephone interviews were completed by the same researcher. Each interview started with a reminder of the confidentiality, purpose of the study and the maximum duration of the interview. Prior to the commencement of the interview, all participants had an opportunity to ask any questions. Equally, at the end of the interview, they were given the same opportunity again. A topic guide was

used to replicate the same experience for all participants and for fairness and consistency of data collection. No participants indicated that they had not understood any of the questions and there was no necessity to clarify anything before, or after the set of questions was delivered. All participants had been given the time required to exhaust their answers, and were prompted at the end of each question with the statements: “Is there anything else you would like to add” and “Are you happy to move on to the next question?”.

Data recording and handling

All interviews were recorded, using the University of Portsmouth CISCO telephone network. The audio files were downloaded in a Wave Audio Form (WAV) immediately after each interview and stored on a password protected Google Drive, managed by the University of Portsmouth. Audio recordings of each interview were transcribed by an independent transcription service, using a smart verbatim style and subsequently prepared for coding.

Data analysis

The transcribed interviews were subjected to a process of thematic analysis with the use of the principles of Glaser and Strauss (1967) Grounded Theory. These approaches are recognised for answering questions from particular groups of respondents and they aim to reduce the complexity of participants’ accounts, by searching for patterns in the data. The process involved the steps of immersion in the data, identification of patterns, coding the data and organising them and then reporting on the findings with the use of direct quotations (Green and Thorogood 2018, p.258).

Results:

Five telephone interviews were conducted and no participant withdrew their consent or any data disclosed in the interview. Each interviewee was assigned a numerical figure, in order to refer to them in this manner for data analysis purposes and manuscript writing.

Codes

The analysis produced 24 meaningful units in the data. These units were given five distinct codes. Coding is a process of applying descriptive labels to qualitative dataset, in order to illuminate key themes within that dataset. This process helps the researcher to elicit the raw data from the textual or visual evidence collected. Appendix B illustrates the codes developed in this study and the dispersion of codes across the participants. One negative case has been identified during the analysis. A negative case is characterised by respondents' experiences or viewpoints differing from the main body of evidence and often, it is believed that these cases strengthen the theory (University of Toronto Scarborough 2018). The negative case identified a positive belief in contrast to the majority of negative examples for the given code. Appendix C, illustrates this code. In the case of the code "Standardisation of the Equipment and Protocols", there were numerous responses regarding the need for one drug to be agreed, being a potential barrier. However, the following response highlighted that there could be a positive solution, with the already existing pharmaceutical intervention, presently available to all paramedics in the UK:

"The paramedics already have access to Benzylpenicillin, purely for meningitis. We took microbiological advice, regarding the management of septic patients, and whether we wanted to introduce a wider spectrum of antibiotics. The conclusion was that we're probably better off sticking with one, because various different units, have various different ideas on what the first line empirical antibiotic would be, and Benzylpenicillin is as good as any other."

(Participant 4)

Themes

The five codes have been converted into the following themes: *Barriers and Enablers; Early Sepsis Recognition; Accurate and Consistent NEWS Scoring; The Need for Primary Evidence; Standardisation of the Equipment and Protocols*. These themes and their corresponding codes, are illustrated in table 1.

Description of the themes

Summary

Each of the themes represents the opinions, of the Medical Directors interviewed. A number of differences, depending on their respective speciality of medicine, were reported. On one end of the spectrum, there were concerns about a potential of an unnecessary use of IV antibiotics, without the ability to test blood cultures in the ambulance service. Whereas, the analysis also identified that with the presence of influential evidence for the efficacy of the intervention and more specifically where long transfer distances may be necessary, this option of treatment could be explored in more depth. Five dominating nodes have been developed and are illustrated and analysed below, with direct quotes from the data. A visual representation of the themes and codes developed, is illustrated by figure 1, in a form of a mind map.

Figure 1. Emerging themes and codes following data analysis.

Emerging themes and codes following data analysis

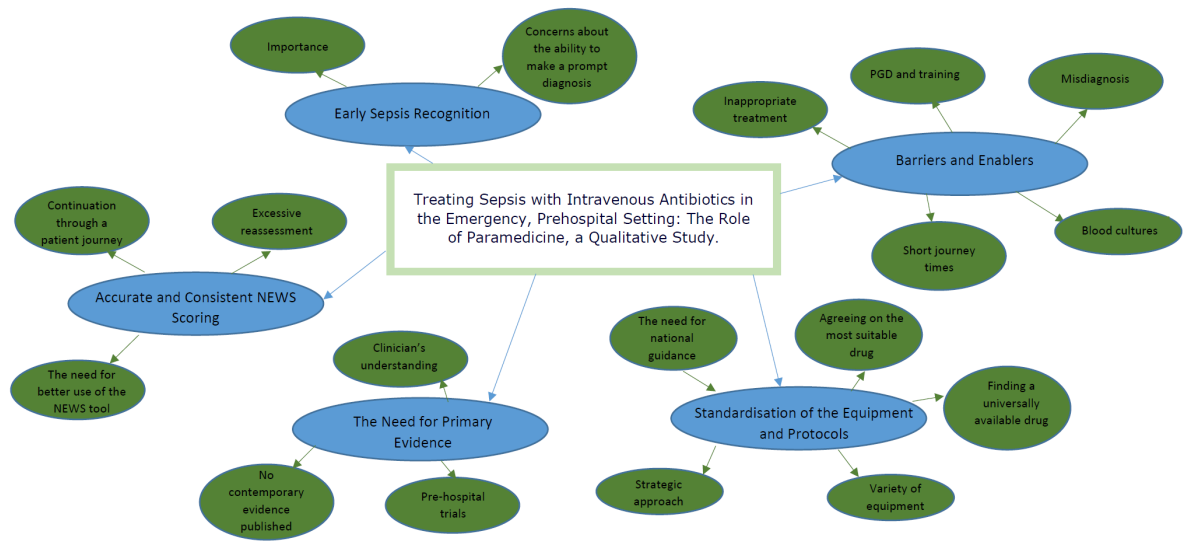


Table 1. Themes and supporting codes, generated during the analysis

Theme	Supporting codes
Barriers and Enablers	Blood cultures, Commencement of an inappropriate treatment, Developing a PGD and training, Short distances between patients and hospitals, Misdiagnosis
Early Sepsis Recognition	Importance of early recognition, Reservations about the current ability to recognise sepsis promptly
Accurate and Consistent NEWS Scoring	GP through to hospital admission continuation, Excessive reassessment at different levels, Better use of NEWS/NEWS2 tool
The Need for Primary Evidence	Clinician’s understanding of what they are doing, Collecting prehospital data, Unproven, Research needed
Standardisation of the Equipment and Protocols	Variety of equipment, Finding a drug that is available to all, Agreeing on the same drug, Need for national guidance, Strategic approach

Barriers and Enablers

This theme reflects participants' concerns and potential enablers, associated with the IV antibiotic therapy being available to prehospital, emergency clinicians for the treatment of sepsis. Numerous participants suggested, that in order to consider such an intervention being available, they would be reassured to have microbial results available, prior to commencing the treatment, in order to identify the specific pathogen causing sepsis:

"I think where ambulance services have got short running times to hospital, then there is an advantage in being able to do blood cultures prior to giving antibiotics. I think the likelihood of getting really solid blood cultures in pre-hospital care, is not great. I think it's a lot easier to do in a hospital environment."

(Participant 3)

A group of participants were concerned about not tailoring the treatment and commencing the inappropriate drug regime, without access to the medical records, which are easily available in the emergency department to all physicians. Additionally, there were concerns about identifying a drug that will be effective and easy to constitute and administer, for the nature of prehospital settings:

"When I'm sitting in the emergency department, I have an integrated prescribing care record. So, as the patient comes in, I know all the drugs the GP gives them, I know all the drugs they've been given in the nursing home recently, and their last dose of everything. I know all their allergies. I also know their risks, much more comprehensively than the history, for many of my patients. Now, we can't give the paramedics Gentamicin, because they don't know the renal function of these patients, et cetera, they can't load it. So, we've got to give them something very basic, that they can load up really quickly and it's got to cover gram -ve sepsis. So, it's got to cover the things that slip through the net for us. So, how are we going to decide what the right antibiotic is? And

the only way I can see that being done, and the way it's done in other ambulance services, is either give something specific for the obvious, or something very, very broad spectrum for the possible."

(Participant 2)

A further barrier has been identified, in order to support the above concerns and the question of a possible misdiagnosis of sepsis and its consequent treatment with IV antibiotics was raised:

"Again you've got to make sure we're clear on what we're treating. I went out with a crew recently, and we had a patient who was dehydrated, hypotensive, tachycardic, who also had a fever. He wasn't septic, he was able to walk around, and mobilise without any difficulty at all, and didn't really fit the full criteria for sepsis, but, if you just looked at NEWS scoring, and the fact that he had a fever, it would suggest that he did, in fact, have sepsis."

(Participant 1)

On the other hand, the majority of participants interviewed, at the same time, recognise the need of early IV antibiotics in sepsis. Some acknowledged that where there are significant transfer delays or where further testing would be available, prehospital sepsis care could be advanced, particularly with the use of advanced paramedics. One participant, felt strongly about this intervention to be delivered in a prehospital arena:

(..) You've got to start antimicrobial therapy as quickly as possible in sepsis, to try and stop it becoming fulminant, so as early as possible intervention, is vital. So, the first dose of antibiotics, should be given in the pre-hospital environment."

(Participant 4)

(...) If the delay was hours, so either we've spent too long trying to get to the patient, because of geography or other reasons, or we've spent too long transferring the patient, because of geography or other reasons, working out a method with the system to give antibiotics earlier to the appropriate patient, is entirely appropriate.

(Participant 2)

"I think the opportunities in the future, that I would like to see, would be access to near patient testing, including lactate assay, which would clearly strengthen the recognition of the sepsis six, accepting that two of them historically have only been able to be established once the patient has arrived in hospital, with access to blood work.

(...) Some of the enablers around that, would be access, perhaps for our specialist paramedics or advanced paramedics, who are now increasingly based and providing support to clinical teams of ambulance clinicians."

(Participant 5)

Early Sepsis Recognition

This theme is related to the emphasis put by the participants, on the early recognition of sepsis, using sepsis recognition tools and utilising pre-alerts to aid the hospitals in their preparations before the patient reached the emergency department and it has been noted by many, that it is important not to cause any additional on-scene delays, once sepsis is suspected:

"We already have a set of pre-agreed criteria for pre-alerting all emergency departments, to the impending arrival of a patient, with a presumed diagnosis of sepsis. We recognise that actually it's important that patients aren't delayed at scene, waiting for an advanced paramedic, particularly if that care can be escalated and delivered on arrival in hospital."

(Participant 5)

“Early resuscitation of very sick patients, spotting a deteriorating patient and resuscitating them, without a doubt, is very important and making the people when you arrive, as a trusted assessor, aware that you’re highly suspicious (...)”

(Participant 2)

It was further suggested that the ability of administering prehospital IV antibiotics would not be a viable argument, in order to reduce the time from sepsis recognition to antimicrobial treatment being administered and the majority would welcome good quality pre-alerts:

“(...)But to argue, that because the hospitals are rubbish, we should give the antibiotics, I don’t support that argument. If we pre-alert correctly and we do our bit correctly, and we spot a deteriorating patient correctly, and we don’t over pre-alert, then that is the hospital’s business to do that.” [It should be noted that the interviewer has quoted retrospective, published data identifying time delays of in-hospital administration of antibiotics, while exploring this point with the participant.]

(Participant 2)

Accurate and consistent NEWS scoring

A large proportion of the participants have expressed their views about the necessity of collecting the NEWS score frequently and consistently, in order to spot the deteriorating patient early:

“One of my concerns is that we are collecting data for NEWS scores, but it’s not until the patient actually gets to hospital, that it starts to be documented and then followed up. So that you then get the first three readings, and the trend line developing in the first three hours of attendance in hospital, whereas the patient may have had an initial assessment by a general practitioner, then an ambulance assessment, and actually he may already have three points of data, at the point of

reaching hospital. Then you should be on to it, and start treatment at a very early stage. So, I think there is already something that could be done to bring that forward, if we have better use of NEWS scoring.”

(Participant 1)

The value of using recognition tools was further emphasised and the importance of not causing additional on scene time delays was stressed:

“To help our staff recognise sepsis, you will recognise a number of the algorithms that we’ve produced to support staff. Additionally, we’ve issued a further update recently, about the value of national early warning scores. About the importance, if feasible, to establishing intravenous access, but not to delay on scene times to achieve that.”

(Participant 5)

Standardisation of the Equipment and Protocols

A theme almost universal to all Medical Directors interviewed, was a challenge of standardising the drug of choice, along with the difficulties of using the same equipment for microbiological testing, that would be compatible with all the labs across the hospital Trusts present in the areas where ambulance services operate. It was additionally speculated, that it could be challenging to develop a Patient Group Directions (PGD) and train the workforce to deliver it, and it was suggested that this could be more likely achieved by selecting the specialist paramedics, as the clinicians who could possibly have access to IV antibiotics in the prehospital arena:

“The practical issue is, that we would need patient group directions for intravenous antibiotics to be used by paramedics. And the whole process of, not just agreeing patient group directions, but also training on them, is quite a significant burden for ambulance services, if you were going to do

it for all paramedics. If you were going to do it for your specialist cohort of paramedics, that's a different matter."

(Participant 3)

The Need for Primary Evidence

This was the least surprising theme that has emerged during data analysis. A number of opinions have been expressed regarding the need of evidence of the efficacy of paramedics administering prehospital IV antibiotics for sepsis, including fear of complicating the ease of the in-hospital diagnosis, the need for the national support for this intervention to be introduced and an internal study being carried out in one Trust, where the findings reported high sensitivity but only approximately 30% specificity, when detecting prehospital sepsis. At the same time, the majority of the Medical Directors have expressed interest in considering this intervention, once the evidence suggests that it is effective with a special interest paid to the remote areas, with long transfer times:

"I'd like to see some data on the benefits of pre-hospital antibiotic usage. My concern would be the risk that we may add into the system about actually treating with an inappropriate antibiotic, which then actually delays or causes increasing morbidity or mortality."

(Participant 1)

"I think all of this stuff needs to be studied, and I think more and more we need to be starting to look at ourselves as part of a system. So, I do support research and an evidence based approach to pre-hospital improved care, which does include giving antibiotics early. But it's just how you get there."

(Participant 4)

Discussion

This study was set out to be qualitative in nature, in order to ask key personnel about their views of a possible use of prehospital, IV antibiotics for treatment of sepsis. Semi-structured telephone interviews have been completed and deemed the most suitable way of collecting data in this study, due to the ability of capturing the participants' true feelings and views. This study has identified a number of themes and provided the evidence never published in the UK, related to a number of Medical Directors' opinions associated with the use of IV antibiotics in prehospital emergency care. The most dominant theme identified the desire for a national drive to accurately and consistently use the NEWS/NEWS 2 scoring tools, in order to standardise how all health care professionals' record and score a level of patients' deterioration.

Following the interviews, it has become evident that the treatment of prehospital sepsis is high on the agenda of the chief clinical decision makers and a number of opportunities have been identified. Pike et al. (2015) evidenced the paramedics' ability to aseptically collect prehospital blood cultures, accurately identify sepsis and commence the appropriate treatment in a timely manner. However, the evidence gathered here, suggests that it may be challenging to reach a national agreement and approach to the use of emergency, prehospital IV antibiotics in sepsis, due to an inability to analyse the blood cultures in the out of hospital setting. This is further complicated by the variations in equipment used across the emergency services, hospitals and microbiology labs. The most powerful and important theme, is perhaps the interest in the evidence, for the out of hospital effectiveness of the proposed intervention, which is currently lacking in the UK. This is further enforced by the call for research from NICE (2017), in order to further understand the effectiveness of the current approach to the treatment of sepsis. There evidently is a significant interest in studying such data, in order to help inform the current protocols and key decision makers and stakeholders.

Following a literature review, only one appropriate study has been found by Alam et al. (2017), suggesting that prehospital administration of IV antibiotics to septic patients, has no benefits in context of mortality 28 days later. However, this study in non UK based and largely looked at patients within urban areas and within a different healthcare system. Therefore, it could be argued that it does not carry a representative result for the British health service and population. NICE Sepsis Recognition, Diagnosis and Early Management guidelines (2017), which are the most contemporary approved clinical practice publications, contain recommendation for further research and one of the recommended themes is a complex service evaluation of implementation of NICE sepsis guidelines. It could be argued that the effectiveness of the current approach is not fully understood. This is particularly of interest of the authors, as the NICE guideline 51, 1.7.3 (2017) advises that ambulance services have mechanisms in place to give antibiotics for high risk patients in pre-hospital settings, where transfer times is more than one hour. Furthermore, no published evidence has been found to date, of what are the transfer times across the UK for septic patients, or how long it takes to extricate these patients, consequently adding to the transfer time and risking breaching the one hour for the proposed antimicrobial treatment being initiated.

On the other hand, a lot of emphasis was placed on rapid transfers where possible, with an appropriate pre-alerting system and sepsis recognition tools being used. These were reinforced by the importance and a drive to NEWS/NEWS2 scoring, in order to improve the current emergency sepsis care. This finding links to the drive and recommendation from The UK Sepsis Trust, on how healthcare professionals can spot sepsis better (The UK Sepsis Trust 2019), adding value and reassurance that the ambulance services are already following the national recommendations to help recognise sepsis rapidly.

Additionally, the current approaches in the respective parts of the country, are inevitably influenced by the experience and position of the Medical Directors, who have the overall decision making influence in their respective services they overlook. Although a number of themes have been

identified, a range of responses varied from being cautious to this pharmacological approach, to a belief that there is an appropriate drug already in possession of the frontline ambulances, which could be utilised and is believed to carry little risk and potential significant benefits. It could be suggested that following the data analysis in this study, the current protocols for the treatment of sepsis in the UK ambulance services are largely influenced by multiple considerations, but in the end, inevitably expert opinion and experience, which differs across the ambulance services. Equally, it is possible that the findings presented and discussed here, can be accounted for, by the methodological considerations discussed below.

Methodological Considerations

Although data saturation was reached within this sample, the results do not represent the saturation of data regarding the research question. This is because, although the purposive sampling has been employed, not all UK Medical Directors contributed to the study. Additionally, based on the specific discipline of medicine each participant represents, they may have different experiences of treating sepsis. A possible solution to this flaw, could be grouping the respondents into the speciality of the profession they represent and conducting the analysis within these groups. The responses could provide further explanation, on why the particular groups feel strongly about something that others may not consider and vice versa.

Another problem, in relation to validity, was that only Medical Directors were used for the purpose of this study and the results are based on their individual perceptions and beliefs. During the analysis, it has become evident that treating sepsis in the ambulance service with the consideration of the use of IV antibiotics, would additionally involve microbiologists, paramedics, pharmacists and indeed patients. Based on this limitation, it could be proposed that all these groups should be interviewed respectively in order to offer a fairer view, from the experience of all involved in the process, rather than just ambulance services Medical Directors.

With regard to telephone interviews themselves, it is noteworthy that asking respondents for their views and opinions, in the circumstances where the loss of participant anonymity is inevitable, has the potential for information to be withheld or biased towards perceived expectations (Farnsworth, 2016).

Conclusions

Sepsis care in the majority of the UK ambulance services is still relatively basic. The published evidence is limited, and what is available is largely quantitative in design, therefore, this study provides valuable new information in the field of prehospital sepsis care. The results of this study suggest that although the common beliefs exist within the population interviewed, there is a difference of opinions within the sample. The current treatment, ranges from the conservative administration of sodium chloride and oxygen, to collecting blood cultures and administering IV antibiotics for prehospital sepsis in the UK ambulance services. Indeed, many of the key decision makers, have a particular interest in exploring advanced approaches to sepsis treatment, but at the same time, are seeking the evidence for the efficacy of the IV antibiotics for the treatment of sepsis, in the emergency prehospital care in the UK. The authors therefore propose, that a large, double blind, randomised controlled trial should be carried out in the UK, investigating the efficacy of IV antibiotics in prehospital sepsis, due to the current lack of quantitative evidence of this nature.

Reference list

Bergin T. 2018. An introduction to data analysis. London: SAGE Publishing.

Daniels R, Nutbeam T, Keep, J. 2015. Paramedics have a clear role to play in the management of patients with sepsis. *Journal of Paramedic Practice*, 7(9):430-432.

Davies G. 2018. Positionality in qualitative analysis: who are we coding for? [Internet]; [cited 2018 Jan 31]. Available from <https://www.bath.ac.uk/publications/qualitative-research-symposium-2018/attachments/qualitative-research-symposium-2018-programme.pdf>

Dudovskiy J. 2018. Purposive Sampling [Internet]; [cited 2019 Feb 27]. Available from <https://research-methodology.net/sampling-in-primary-data-collection/purposive-sampling/>

Farnsworth B. 2016. What is participant bias? (And How to Defeat it). [Internet]; [cited 2019 Mar 1] Available from <https://imotions.com/blog/participant-bias/>

Green J, Thorogood N. 2018. *Qualitative methods for health research*. 4th ed. London: SAGE Publishing.

Kumar A, Roberts D, Kenneth D, Light B, Parrillo, J, Sharma S, (. . .) Cheang M. 2016. Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. *Critical Care Medicine* 34(6):1589-1596.

Mills AJ, Durepos G, Wiebe E. 2010. Reflexivity. [Internet]. *Encyclopedia of Case Study Research*; [cited 2019 Jul 3]. Available from: <https://methods.sagepub.com/Reference/encyc-of-case-study-research/n290.xml>

National Institute for Health and Care Excellence. 2016. [Internet]. Sepsis: recognition, diagnosis and early management; [cited 2018 Oct 19]. Available from <https://www.nice.org.uk/guidance/NG51>

Pike J, Wood B, Themimulle S, Cumming D, Lawal-Reiley T, Ballington J, (. . .) & Andrewes R. 2015. Can paramedics treat sepsis?. Journal of Paramedic Practice. [Internet]. [cited 2017 May 24];7(9): 454-458. Available from <http://dx.doi.org/10.12968/jpa.2015.7.9.454>

Qureshi K, Rajah A. 2008. Septic Shock: A Review Article. BJMP. [Internet]. [cited 2018 Aug 29];1(2);7-12. Available from <https://www.bjmp.org/content/septic-shock-review-article>

Sepsis Trust UK, College of Paramedics. 2014. [Internet] Executive Summary: Prehospital management of sepsis.[cited 2018 Jan 22]. Available from <http://sepsistrust.org/wp-content/uploads/2015/08/1409315060PHExecSummary2014.pdf>

Steinmo SH, Michie S, Fuller C, Stanley S, Stapleton C, Stone SP. 2016. Bridging the gap between pragmatic intervention design and theory: using behavioural science tools to modify an existing quality improvement programme to implement “Sepsis Six”. Implementation Science [Internet]. [cited 2018 Nov 2]; 11(14): 1-12. Available from <http://dx.doi.org/10.1186/s13012-016-0376-8>

The UK Sepsis Trust. 2016. Understanding Sepsis. [Internet]. [cited 2018 Jul 11]. Available from <http://sepsistrust.org>

Thomas DR, Hodges I. 2010. Designing and Planning Your Research Project: Core Skills for Social and Health Practitioners. London: SAGE Publications.

University of Toronto Scarborough. 2018. The Use of Negative Cases and Unexpected Findings. [Internet]. [cited 2018 Dec 2]. Available from <https://www.utoronto.ca/~pchsiung/LAL/interviewing/complexity/negative>.

Appendices

Appendix A: The search strategy

Search terms	<p><u>Initial Search:</u></p> <p>Pre-Hospital OR Ambulance Intravenous OR IV Antibiotics in sep*</p> <p><u>Secondary Search:</u></p> <p>Intravenous or IV antibiotic* AND hospital OR Emergency AND sep* AND outcomes</p> <p>Limited to the following or the combination of, depending on the data base filters available:</p> <ul style="list-style-type: none"> • Linked to full text • Human • Journals only • Published between 2000 and 2017 • Trials
Databases searched	<p>CINAHL The Cochrane Library Medline PsycInfo PubMed Science Direct Scopus Web of Science Joanna Briggs Institute EBP Practice</p>
Part of journals searched	<p>Record Title</p> <p>Abstract</p> <p>Key words</p>

Years of search	2000 – 2017
Language	English
Types of studies to be included	All available studies
Inclusion criteria	Sepsis Severe Sepsis Septic Shock English Language
Exclusion criteria	Neonatal Sepsis Administration of medicines other than broad spectrum antibiotics Non-English Speaking Countries

Appendix B: Table of indexing codes

Code	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Total
Barriers and Enablers	2	1	1	4	2	10
Early Sepsis Recognition	1	2	4	1	1	9

Accurate and Consistent NEWS Scoring	3	2	1	3	4	13
The Need for Primary Evidence	2	1	3	1	4	11
Standardisation of the Equipment and Protocols	1	2	1	5	2	11

Appendix C: Table of negative cases

Code	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Total
Standardisation of the Equipment and Protocols	0	0	0	1	0	1