**Title: Is hospital the best place for patient with infective
endocarditis : A review of the literature**

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Introduction

Despite advent of antibiotics and evolution of surgery the treatment regime for infective endocarditis continues to involve a long courses of intravenous antibiotics. With a focus on potential complications, high and significant hospital mortality, minimal attention has been given to whether it is best to manage patients with infective endocarditis in hospital or home.

INTRODUCTION

Infective endocarditis occurs when microorganisms colonise the endocardial surface of the heart and/or valves, causing tissue damage and destruction. It may, through proliferation of the microorganism, form a platelet-fibrin-infective mass called a vegetation, which has the potential to cause systemic emboli (Mason 2002). If left untreated the progression of the disease leads to death from heart failure, embolic events such as pulmonary embolism, cerebral vascular accident, or organ failure related to uncontrolled septicaemia. The advent of antibiotics, evolution of cardiac surgery and progress in diagnostic techniques, has seen significant improvement in patient care outcomes. In spite of these developments however, infective endocarditis remains a serious condition with an associated hospital mortality of 15-25% (Castillo et al 2000, Netzer et al 2000, McNeill 2000, Mason 2002, Swanton 2003). This review aims to critically analyse and synthesise evidence emerging from published sources regarding managing and treating patients with infective endocarditis in an effort to promote and highlight the best evidence for practice.

Treatment of infective endocarditis involves long-term intravenous antibiotics of 4-6 weeks to eradicate the organism, the possibility of surgical intervention to replace the damaged heart valves or the potential to develop complications caused by embolic events. Eighty percent of all patients diagnosed with infective endocarditis will develop complications (Castillo et al 2000). Traditionally, management of infective endocarditis has required patients to remain in an acute hospital setting for the duration of treatment. Arguably, this prolonged length of hospital stay involves a high cost per year to the NHS and may also have a significant impact on the overall quality of the patient experience.

Patients are often acutely ill, requiring close monitoring for potential complications. Once the treatment is commenced, patients may begin to feel better but are required to remain as an inpatient for the duration of their treatment. Occasionally, a patient may be discharged on daily dose of intravenous antibiotics via the local community intravenous antibiotic service. However the majority of patients are required to remain a hospital inpatient. This clearly highlights the inconsistency and inequity of current treatment.

Politically, the labour government is attempting to modernise the NHS by focusing on quality, accountability, efficiency and effectiveness of the care it provides. Evidence-based practice is the hallmark of this initiative (Department of Health 1997). Increasingly, patients are encouraged to have a voice within this new NHS model. Thus ensuring greater choices are available to patients about how and where they wish to be treated (Department of Health 2004a). Nursing and nurses are central to the successfully implementation and development of this political and clinical initiative.

Clinically, target setting and greater expectations of patients has placed increasing demands within the acute care sector for beds as the drive for increased efficiency and effectiveness become the benchmark against which standards of treatment are currently measured and monitored.

Professionally the Nursing and Midwifery Council which guides nursing practice through the Code of Conduct (Nursing and Midwifery Council 2002) clearly defines that nurses should promote the interests of patients and clients, which includes helping individuals and groups gain access to health and social care, information and support relevant to their needs. Home intravenous therapy appears to be available

to a select group of patients with infective endocarditis thus highlighting a fragmented and inequitable service. Nurses' responsibilities are centred on the delivery of evidenced-based care, promotion of health care environments that are conducive to safe, therapeutic and ethical practice (Nursing and Midwifery Council 2002). In the process of identifying evidence on which to underpin practice Pearson and Field (2005) argue that the construction of a clear well defined question is imperative to provide focus and direction to a study.

Within this article the following research question will be explored.

"Do adult patients who are being treated for infective endocarditis have to stay in hospital?"

Methodology

A literature review plays an important role in summarising current knowledge, major issues and disseminating information generated by a large number of individuals (Hart 1998). In the context of this study, critical analysis of the literature is vital in order to gain insight into this phenomena to inform and influence practice.

MEDLINE, CINAHL, EMBASE databases and Cochrane databases were searched identifying literature published from 1995 and written in English. This span of 10 years was chosen to provide the most current articles relevant to the subject.

Key words used were endocarditis, treatment, management, care or intervention, intravenous or parenteral antibiotics, hospital home or community, either separately or in combination. All studies, regardless of methodological composition were included to maximise the results and potentially relevant articles were reviewed. An explicit inclusion criteria was developed to ensure chosen articles reflected the aims of the review and answered the research question. Ones related to adults, pertaining to the management, treatment or care interventions for endocarditis and

home, community or outpatient intravenous antibiotic therapies were included. Specific organisms and subsequent antibiotic therapy, prophylactic or surgical intervention, or the practical administration of intravenous antibiotics were excluded since evaluating these treatment models was not the aim of the study. A total of 45 articles met the specific criteria.

Key themes emerging from the literature review included the current medical management of endocarditis, the development of intravenous antibiotic administration within community setting and how these patients can be managed at home with intravenous therapy. These themes are analysed and discussed within this review.

Current medical management of endocarditis

A dearth of evidence exists describing the overall condition and management of endocarditis (Giessel, Koeing and Blake 2000, Thornton 2000, Mylonakis and Calderwood 2001, Erkyn 2001, Dhawan 2003, Moreillon and Que 2004). Consensus within this evidence highlights key points relating to the specific management of infective endocarditis that include the need for blood cultures to identify the causative organism (Giessel et al 2000, Thornton 2000) and the use of transthoracic and transoesophageal echocardiogram to establish underlying cardiac conditions or vegetations (Erkyn 2001). The European Society of Cardiology (2004) has culminated evidence to provide best practice guidelines when managing these patients.

However, difficulties in early diagnosis and management of patients arise because of the complex nature and presentation of infective endocarditis. Signs and symptoms are varied (Mylonakis and Calderwood 2001, Dhawan 2003). Presentations of infective endocarditis are often non-specific and include lethargy, malaise, backache; night sweats and weight loss, which may mimic other conditions. Clinical

manifestation may be dominated by an embolic event such as a stroke directing diagnosis away from the underlying cause (Netzer et al 2000). Even on physical examination clinical evidence of valvular dysfunction may not be evident on admission.

This diagnostic dilemma is well recognised (Calkins and Vasa 2000, Prendergast 2004). Diagnostic criteria have been used to aid diagnosis (Durack et al 1994). The European Society of Cardiology (2004) has omitted such a tool in the guidelines as

‘even the most elaborate algorithm on the diagnosis and treatment has little impact if the diagnosis is not suspected enough (page 9)’.

Once diagnosis has been confirmed the goal of treatment is to produce therapeutic drugs levels at the infected site for a maximum period of time (European Society of Cardiology 2004). Due to the pathogenesis of the disease forming infective vegetations, the course of antibiotics for 4- 6 weeks has been proven to be the most effective treatment model to eradicate the infection (Morellion and Que 2004, European Society of Cardiology 2004). Studies (Hummer et al 1999, Dhawan 2003) challenge this practice and argue that the use of a two-week course of antibiotics may be appropriate in specific cases. Currently, clinical practice appears not to be following these recommendations

Numerous studies (Castillo et al 2000, Wallace et al 2002, Vilacosta et al 2002, Deprele et al 2004) have concentrated on the prognosis and the assessment of risk, with the medical profession searching for the ideal framework to effectively assess and manage patients with infective endocarditis by accurately predicting the outcomes. It is important to understand the potential risks and complications that can occur with infective endocarditis as this has a direct relationship to the possibility of managing the care of these patients outside the hospital setting.

Identifying potential risks of infective endocarditis

There is a changing profile of endocarditis although, the incidence, symptoms, presentation and course of the disease has remained unchanged (Hoen et al 2002). There is an increase of patients who have no underlying cardiac condition and an increase in the age of the patients due to degenerative valve disease (Netzer et al 2000). Despite the introduction of new diagnostic tools such as transoesophageal echocardiogram, the introduction of more powerful antibiotics and more effective modes of administration, hospital mortality remains as high 15%. Delays in diagnosis or prior antibiotic therapy may adversely influence symptom duration and outcome and mortality is high in patients displaying short duration of symptoms before diagnosis (Issa et al 2003). Large vegetations of $\geq 10\text{mm}$ on the heart valve places patients at greater risk of embolic event highlighting the value and importance of early diagnosis and treatment. Routine blood tests that reveal abnormal white cell count, serum albumin concentration, serum creatinine concentration or cardiac dysrhythmia during the first 48hrs of treatment conferred a poor prognosis (Wallace et al 2002). These findings may be influential in identifying patients unsuitable for treatment at home with antibiotic therapy.

It could be argued that the complexity and variables of presentation, difficulties in diagnosis, potential of complications and prognosis make it difficult to identify a model of care that fits all these patients. It is from this stance that teamwork is advocated to manage this decision-making process in more of a collaborative manner (European Society of Cardiology 2004). However, the lack of evidence for accountability for these decisions and the potential outcome of these cases finds the medical profession focusing their efforts on scientific inquiry and treatment regimes rather patient and their needs. The inclusion of the patient's perspective is vital to meet the new NHS model (Department of Health 2005).

Development of intravenous antibiotic administration within community setting for endocarditis patients.

Within the literature paucity of data exists exploring the wider implications of endocarditis on the patient. There is token reference to the sociological and physiological effect of long-term treatment. Home antibiotic therapy for this client group has been considered through written proposals of outpatient antibiotic therapy in clinically stable patients (Rehm 1998, Huminer et al 1999, Lopardo 2001). This review has highlighted the difficulty in identifying the 'clinically stable' patient with infective endocarditis.

The validity and effectiveness of home antibiotic therapy has been successfully demonstrated in studies in other countries where home therapy is already established for a variety of conditions such as soft tissue infections, bone and joint infections (Huminer et al 1999, Lopardo 2001, Laupland et al 2002). Of these studies single or twice daily doses of antibiotics either as an outpatient, home visiting nurse or self-medication were used. Patients were specifically selected who were stable in hospital and were followed up closely at home by nurse or medical practitioner. Lopardo (2001) found 33% of the patients had a complication relating to infective endocarditis while in hospital, but once stable could be successfully managed at home and all were successfully managed and treated. Huminer et al (1999) found that 6 out of the 38 patients required rehospitalisation for management of complications of endocarditis, which included surgical intervention, recurrent fever or SVT. Treatment of these complications was successful in 92% of cases. Factors that made the service successful included selection of patients whose infection is under control, usually after a period of hospitalisation. Patients who all lived close to hospital and were supervised closely by a qualified physician, and frequent contact with the patients at hospital or home. These are important considerations to acknowledge when devising a home care programme.

The European guidelines for infective endocarditis (European Society of Cardiology 2004) support home antibiotic therapy and advocate multidisciplinary assessment in hospital for 1-2 weeks to commence treatment and observe complications. These guidelines suggest a significant proportion of patients with endocarditis could be candidates for outpatient antibiotic therapy but gives no indication of the number of patients this would involve or address the practicalities of managing these patients at home. Regardless of the complexity of the disease and potential complications, review of the literature continues to demonstrate that infective endocarditis is a condition that is amenable to treatment outside the acute care setting (Rehm 1998, Huminer et al 1999, Lopardo 2001). Despite this less than 5% of all patients treated with intravenous antibiotics outside hospital have endocarditis (Rehm 1998).

More generally, evidence is available in many countries that antibiotics can be administered safely in a non-acute setting (Nathwani 1995, Grayson et al 1995, Nathwani and Davy 1996, Huminer et al 1999, Nathwani et al 1999, Kayley 2000, Lopardo 2001, Deagle 2001, Laupland et al 2002, Cooper 2003). However, these services are fragmented and diverse. Home intravenous antibiotic therapy is used to treat a variety of conditions and infections such as skin and soft tissue infections, bone and joint sepsis (Nathwani et al 1999). All medical conditions included in all the studies have common criteria that the patient must be clinically stable and no longer require hospital treatment, but require further antibiotic therapy (Grayson et al 1995, Nathwani 1995, Huminer et al 1999, Lopardo 2001, Goodfellow et al 2002).

In countries where funding for health care is through personal payment or insurance, home intravenous antibiotic therapy services have been effectively developed within a business paradigm which provides 24 hour access to medical care and support (Graves 1995, Dalovisio et al 2000, Tice et al 2002). In the UK the development of these programs has been on a much smaller scale and appears dependant on motivation of an individual practitioner developing and implementing the service

(Deagle 2001, Kayley 2003). Kayley (2003) argues that the rationale for the delay in expanding these services is related to issues of funding. In the UK funding for health services arises from the primary health care trust, whilst the drive to deliver this service comes from within the acute care setting. Although home intravenous antibiotic therapy is perceived as a valuable service this is not reflected in the allocation of resources. Often, the main funding for the intravenous antibiotic therapy service comes from specialised services such as the bone infection units, therefore a significant percentage of patients arise from this speciality. Arguably this fragments and concentrates intravenous antibiotic therapy for a group of patients with a specific pathology. This model of practice is common for home intravenous therapy programmes in the UK (Nathwani 1995, , Nathwani and Davey 1996, Kayley 2003), however; recently this model has been reevaluated (Laupland et al 2002, Cooper 2003). In Canada, a 'home parenteral therapy programme' has been developed by amalgamating existing parenteral therapy services. Consequently, home intravenous therapy service is more robust and flexible with the service being developed around the goal to treat 'all who require this route of treatment but who otherwise do not need hospitalisation'.

Models to manage patients with endocarditis in the community

Patients with infective endocarditis have the potential to develop complications (Vilacosta et al 2002, Issa et al 2003, Deprele et al 2004). Regular medical review is advocated in this client group (Rehm 1998, Huminer et al 1999, Lopardo 2001) and ability to attend outpatients is required. This highlights the need to involve patients in the service development.

Studies have explored various methods of administration of antibiotics, some self-administered, others used visiting nurses or outpatient departments (Huminer et al 1999, Nathwani et al 1999, Lopardo 2001). Chambers et al (2004) used a patient

questionnaire of 100 consecutive patients enrolled on a home intravenous therapy programme and found that 14% self-administered intravenous antibiotics at home and would do so again and a further 27% would have liked to have been offered the choice. No evidence was provided to justify why different administration methods were used. This area should be explored further if the government incentives to make the patient more knowledgeable and have the choice of treatment and care are to be realised (Department of Health 2004b). Justification for further exploration arises from evidence that self-administration allows more control over treatment (Nathwani 1995), greater independence (Dalovisio et al 2003) and ownership (Alderman 1998). Dalovisio et al (2003) found that self-administration was associated with reduced costs, which with scarce resources would provide a further rationale for further study.

The literature highlights that single or twice daily dosing antibiotics as a criteria for inclusion in a home antibiotic program. The rationale for this was improved compliance, ease of administration and acceptability (Nathwani 1995, Rehm 1998, Dalovisio et al 2003). Kayley (2000) stated 'more frequent dosing regimes require more health care professional cover or highly motivated patients/ carers to cope with the regime'. No substantiated evidence could be found to support this assumption. Clinically, courses of antibiotic treatment for endocarditis can be four to six hourly regimes, therefore further exploration of this criteria is required if more patients with infective endocarditis are to be included within the home antibiotic therapy model.

Studies examined feature the safety of home intravenous antibiotics (Nathwani et al 1999, Dalovisio et al 2003) and found a small percentage of re-admissions are unrelated to the intravenous therapy and include pneumonia, chest pain, wound infection, hepatic failure (Nathwani et al 1999). Complications with the vascular access device such as breakage, leakage or infiltration were managed at home (Nathwani et al 1999, Chambers et al 2002, Dalovisio et al 2003). Nathwani et al

(1999) found 6% had complications due to a drug reaction but there was no increase in morbidity or mortality.

Benefits of home IV therapy

Patient benefits, cost containment and reduced exposure to hospital-acquired infection have been attributed as the main advantages to outpatient intravenous therapy. (Bramwell et al 1995, Dalovisio et al 2000, Chambers et al 2004) Patients consistently highlight that they preferred to be at home rather than an in-patient. Bramwell et al (1995) argues that being at home reduces disruption of family life and patient benefit from home cooking. The benefit of home cooking cannot be underestimated in patients with infective endocarditis as most have significant weight loss due to systemic infection, anaemia and general malaise (Netzer et al 2000). Home intravenous antibiotic therapy has been proven to provide cost savings to health care providers (Grayson et al 1995, Dalovisio et al 2003).

Another significant benefit would be reduced exposure to hospital infections that currently account for 1 in 10 cases in the hospitalised patient (Graham 1993 cited in Nathwani et al 1999). Levels of infection are escalating in healthcare and currently the British Government are targeting measures to lower rates of infection (Department of Health 2004b). Arguably, moving care for this vulnerable group of patients to the community would be in their best interest. The potential benefits of this service are clearly evident, but challenges for this model do exist.

Barriers to home IV therapy

Nathwani and Davey (1996) in their survey of medical staff describe perceived barriers to home intravenous antibiotic therapy as the reluctant to try something new, lack of good evidence, practical organization of the service and the reduction of beds due to the reduced need. There is concern in the community by GPs who would be

prescribing outside their experience (Nathwani 1995, Nathwani and Davey 1996, Kayley 2003). Specialist knowledge is required and clarification is needed regarding who is best positioned to provide the continued management of patients with endocarditis in the community.

Home antibiotic therapy is safe and effective alternative to inpatient care for specifically selected patients. It has argued that patient choice is central to service development. However, development of a home intravenous antibiotic therapy service is complex and a significant number of issues require careful exploration and acknowledgement before this service can be successfully implemented for patients with infective endocarditis. Funding for the service is fragmented and inconsistent. The service provided and models utilised in the UK are varied and have different outcomes and priorities. Therefore a more co-ordinated model needs to be developed and evaluated.

Discussion

Analysis of the literature has identified the treatment and management of patients with infective endocarditis has remained relatively unchanged for the past 10 years. Once diagnosis is established the infecting organism identified and treatment commenced via eradication through anti-microbial therapy (Mylonakis and Calderwood 2001, European Society of Cardiology 2004). Clinical dilemmas continue regarding the management of this disease. The potential for mortality remains as high at 15% and 80% of patients will experience complications as a direct result of the infection (Castillo et al 2000). However, evidence for the risk criteria is based on retrospective studies, which judge past practice, paucity of data exists that challenges these assumptions. The heterogeneous nature of the disease makes it problematic to predict scientific and potential outcomes because of the number of variables and the diverse presentation of symptoms. Lack of evidence supporting the wider implications of the disease such as the impact the length of stay

has on the patient both psychologically and socially. As the focus of health care moves towards a patient led model it is important that the patient voice is heard and acknowledged. Patients should be empowered to make their own decisions about their care, where they wish to be treated and services devised to fit this care package. Selected patients are already being treated by established community care services in some countries, by providing a more substantial service outside the hospital setting in the UK may encourage more health care providers to use and further develop this service.

The literature review has highlighted difficulties within the funding models utilised. Where funding is sourced from insurance or direct payment this service had been well establish to provide care for a variety of conditions. In the United Kingdom, funding derives from the primary health care trusts, but the promotion of this service is from acute care sector. Variations in funding make it difficult to establish a service to care for a variety of conditions and instead the services focuses specifically on certain key conditions such as bone infection, or cystic fibrosis. This leads to a fragmented and inequitable service that may appear elitist. A more inclusive model therefore needs to be developed that is capable of treating and managing all aspects of infective endocarditis.

The literature has demonstrated patients are capable of intravenous antibiotic administration (Aldermann 1998, Chambers et al 2004). Suitable training and education is needed for patients and their careers to undertake this role. However, for any change to occur the medical profession would need to have confidence in the service as they continue to have overriding responsibility for these patients. This highlights the need for more rigorous and robust research in this topic.

A good literature review provides essential, relevant information to put current study into the context of present knowledge and research available on a topic (Parahoo 1997). This literature review has provided valuable evidence to challenge practice and highlighted many issues, which need to be examined in order for patients with infective endocarditis to be managed at home. It is important to acknowledge the limitations of the review to provide integrity to the findings (Polit and Beck 2004). A criticism of a literature review as a research methodology is that despite the lengths to apply rigor they often reflect a particular perspective or standpoint of the reviewer (Hart 1998). Strategies were implemented throughout the study to attempt to overcome these biases but this did present a significant challenge. Challenges faced in undertaking this review centred on the collation of the results from the analysis of the studies. It was difficult to provide the information, clearly, concisely and logically due to the variety of information sourced.

Conclusion

Examination of the literature has demonstrated that infective endocarditis is complex condition, which requires many clinical judgements to be made. This review argues that difficulty continues in providing a model of care that would suit all patients with infective endocarditis. Arguably, this means that currently medical care continues to focus on predicting outcomes in order to safely manage these patients. In order for practice to move forward further promotion for an alternative method to manage these patients needs to be explored implemented and evaluated. This change is supported by the literature, but has yet to make the transition into practice.

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Key points

- Despite evolution of antibiotics and cardiac surgery the use of long term intravenous antibiotics to irradiate the disease has not changed.
- Evidence shows that infective endocarditis is a difficult disease to diagnose.
- Due to the high mortality and morbidity of the disease, medical research has focused on trying to predict the likely prognosis of the disease, with little reference to the patients' preference of treatment.
- Small studies have shown that it is possible to manage these people at home.
- In order for this to become a feasible treatment option the current use and funding of home intravenous therapy programmes need to be explored further.
- In order met the NMC requirement to provide evidence based practice, continuing to treat patients in hospital and not take responsibility for their own health needs to be questioned

Key words

Endocarditis

Treatment

Home intravenous therapy