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An antibiotic formulary for a tertiary care foot clinic: admission avoidance using intramuscular antibiotics for borderline foot infections in people with diabetes

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Abstract

Aims To develop an antibiotic foot formulary for the empirical treatment of diabetes-related foot infections presenting to our service. Subsequently, to asses costs associated with the introduction of our protocol, in particular to assess the effect on admissions avoidance and any cost savings achieved.

Methods We reviewed several existing antibiotic protocols. We analysed data on costs related to treatment and admission rates prior to and after the introduction of the protocol.

Results We rationalized our antibiotic protocol and adapted the Infectious Disease Society of America guideline by introducing a category of 'moderate infection—borderline admission' to our classification. This enabled the administration of outpatient intramuscular antibiotics. After introducing the rationalized protocol, our average antibiotic prescribing costs for a 3-week course of treatment fell from £17.12 to £16.42. Over 22 months of follow-up, 26 episodes were eligible for treatment with intramuscular antibiotics. Over the same time period, 121 people were admitted directly from the foot clinic. The costs saved as a result of avoided or delayed admission for those 26 episodes was over £76 000. For 12 people who required subsequent admission, their length of hospital stay was significantly shorter than those admitted directly [9.25 days (range 2–25) vs. 16.11 (2–64), $P = 0.045$].

Conclusions By modifying the Infectious Disease Society of America classification and adopting a protocol to administer outpatient oral and intramuscular antibiotics, we have led to substantial cost savings, shorter hospital admissions and also have developed a successful admissions avoidance strategy.

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Introduction

Foot infection in people with diabetes is a very common complication, with previous work showing that up to 58% of diabetes-related foot ulcers were infected [1]. Foot infections remain one of the commonest diabetes-related causes of acute hospital admission [2]. Previous work has shown that people with diabetes stay in hospital for longer than those without diabetes admitted for the same conditions [3], accounting for an annual cost of between £257 m and £262 m [4].

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To date, the choice of antibiotic regimen for use in diabetes-related foot infections has largely remained at the discretion of the prescribing physician. The choice of antibiotic has been guided by culture results, microbiological sensitivity and local resistance patterns, as well as physician experience and preference. Often, culture results are unhelpful because they are of poor quality as they are taken superficially and are more likely to be polymicrobial when compared with patients without diabetes. Deep tissue samples or swab cultures are key to guiding antibiotic choice and therefore should always be sought when treatment is being considered. Where cultures have been unhelpful—because there has been no significant growth or assumed commensal

growth, or before microbiological results being available—practice guidance for rational treatment options have often been unsupported by robust evidence. Empirical therapy using narrow spectrum antibiotics active against aerobic gram-positive cocci are the most commonly prescribed agents because these are the predominant microorganisms that colonize and infect ulcers, with *Staphylococcus aureus* being the most commonly isolated pathogen [5,6]. Broad spectrum empirical therapy is only indicated for severe infections and for infections in ischaemic feet [6]. It has also been recommended that the choice of this empirical antibiotic therapy and the route of its administration should be determined by the severity of the infection and the likely aetiological organisms [6]. The UK National Institute for Health and Clinical Excellence (NICE) added the caveat that the antibiotic with the lowest acquisition costs be used [7].

In 2008 we reconfigured the services offered by our multidisciplinary diabetes foot clinic. As part of this we recognized that we needed a more cohesive approach to empirical antibiotic prescribing because, until that time, there was no formal protocol in place.

In the development of our own empirical antibiotic protocol, we reviewed several guidelines. We felt that the guideline of the Infectious Disease Society of America (IDSA), whilst excellent and widely used, was limiting because it relied mainly on the use of oral antibiotics in the outpatient setting for those who did not need hospitalization, or intravenous antibiotics for those who did. We thought there was a category of patients for whom their infections were too severe for oral antibiotics alone, but for whom hospitalization was potentially avoidable. We termed this degree of infection as 'moderate infection—borderline admission'.

Aim

To assess the impact of empirical intramuscular antibiotic use in the treatment of 'moderate infection—borderline admission' foot infections. In particular to assess the impacts of admissions avoidance and any cost savings achieved.

Methods

Protocol development

The notes of all patients who were seen in the diabetes foot clinic between March 1997 and October 2010 were reviewed. Only those people seen for the first time with a new infected foot lesion who needed empirical oral treatment were included in the analysis. Those who had a new lesion but who had had microbiological samples sent that identified an organism were excluded.

The costs associated with those antibiotics were then analysed, assuming an average 3-week course of treatment using the prices according to the British National Formulary in 2010 [8].

All of the professionals involved in our reconfigured multidisciplinary clinic (diabetologists, vascular and orthopaedic surgeons, microbiologists, podiatrists and specialist antimicrobial pharmacists) reviewed existing local, national and international guidelines for treating diabetes-related foot infections. Qualitative and comparative analysis of the content and citations within these guidelines were performed with respect to antibiotic policy, drug sensitivity and resistance patterns. Systematic reviews on prescription patterns were excluded because of a lack of practice recommendations. The lack of standardization among these trials made the comparison of outcomes of different regimens difficult and often inappropriate. On the basis of the available studies, no single drug or combination of agents appeared to be superior to others [9]. We employed the IDSA Diabetes Infection Classification System to grade infections [10,11], in conjunction with studies on prevalent pathogens within diabetes-related foot infections. Local resistance patterns were taken into account, as was the risk/benefit ratio of prescribing agents associated with higher risk of developing *Clostridium difficile* infection.

In accordance with the IDSA guideline, we believed a graded response was necessary, depending on the clinical severity of the infection, with agents changing or being added as patients changed from mild or moderate to severe infections [10]. The decision tree used in the clinic is shown in Fig. 1. Agents were altered as necessary if microbiological sensitivities became available.

The protocol was developed to use the fewest number of agents possible whilst maintaining the use of narrow spectrum agents wherever possible.

Another cost analysis was carried out after the introduction of the protocol. All the notes of those patients with active lesions were reviewed. Those who fulfilled the inclusion criteria were included and once again looked at whether antibiotic prescribing practices had changed after introduction of the protocol. Costs were reanalysed, again using an average 3 weeks of prescribing based on 2010 British National Formulary prices.

Intramuscular antibiotic use

We knew that our local primary care teams were unable to administer intravenous antibiotics in the community. This was in part because of the skill mix of the district and primary care nurses. In addition, we wanted to develop a method of antibiotic prescribing that allowed for admission avoidance. Thus, we decided to amend the IDSA guideline by inserting an extra category of 'moderate infection—borderline admission'. This was defined as 'cellulitis of > 2 cm around the ulcer associated with a) lymphangitis or b) the foot failing to respond to oral antibiotics alone with the patient not being systemically unwell'. To minimize the impact on district nurses and primary care, and to reduce the need for insertion and care of intravenous lines, we decided

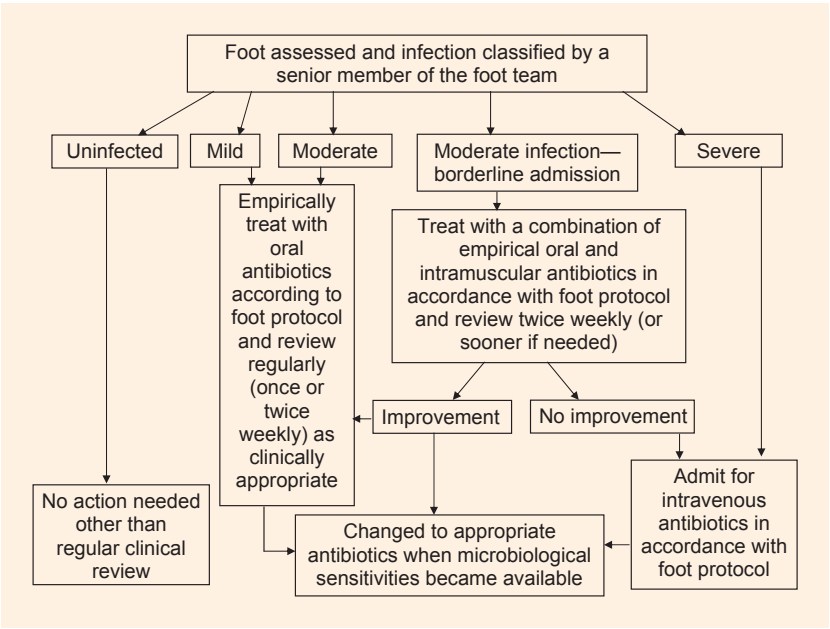

FIGURE 1 The decision tree on which method of treatment was used and when.

to use intramuscular antibiotics, given once daily in combination with oral antibiotics.

We subsequently analysed the outcomes and costs associated for those individuals who were treated with the intramuscular and oral antibiotic regimen and compared them with those who were admitted directly with severe infections for intravenous treatment.

Results

Protocol development

Two hundred and eighty-eight case notes were available for analysis. Of these, 144 patients (50%) were excluded because they either did not have a diabetes-related foot infection or they were not prescribed oral antibiotics empirically because of previous organisms and their sensitivities being available. Data were available for 64 of these patients who had been treated prior to the introduction of the protocol; the remaining 80 patients were treated after its introduction. We assessed the empirical antimicrobial prescribing regime before and after the introduction of the protocol. Data from before the protocol was introduced showed that we had 19 different antimicrobial regimes; these are shown in Fig. 2.

The most commonly prescribed regimen prior to the introduction of the protocol was the combination of amoxicillin 500 mg three times daily and flucloxacillin 500 mg four times daily. The second most commonly prescribed regimen was amoxicillin 500 mg three times daily, flucloxacillin 500 mg four times daily and metronidazole 400 mg three times daily. The cheapest regimen prescribed was erythromycin 500 mg four times daily. The costs per patient for an average 3-week course of these regimens were £16.50, £20.85 and £12.24, respectively.

The overall average cost per patient for an average 3-week cost on any of the pre-protocol regimes was £17.12 per patient. The clinical indications for empirical antibiotic prescribing of these 64 patients are shown in Fig. 3.

Of the 64 patients treated prior to the introduction of the protocol, only 53% grew any organisms from appropriate deep-tissue samples. Almost all were sensitive to the empirical agents prescribed. Only two grew microorganisms resistant to the antibiotics, of which one was a new case of methicillin-resistant *Staphylococcus aureus*.

The antibiotic foot policy that we developed is shown in Table 1.

We then analysed the notes of the 80 patients treated after the introduction of the protocol who fulfilled the inclusion criteria. These data showed that antimicrobial prescribing had been rationalized; the data are shown in Fig. 4.

The most commonly prescribed regimen was co-amoxiclav 625 mg three times daily, with an estimated cost of £16.29 per patient for a 3-week course. The most expensive regimen was prescribed by non-foot specialists attending the clinic. This was co-amoxiclav 375 mg three times daily, ciprofloxacin 500 mg twice daily and metronidazole 400 mg three times daily, at an estimated cost of £20.00 per patient per 3-week course. Because co-amoxiclav provides sufficient anaerobic cover, it was not necessary to co-prescribe metronidazole, thus was not in the protocol.

Despite the predominant use of co-amoxiclav, clindamycin and ciprofloxacin, three agents associated with frequent *C. difficile* infection, no patients got this complication throughout the period under assessment.

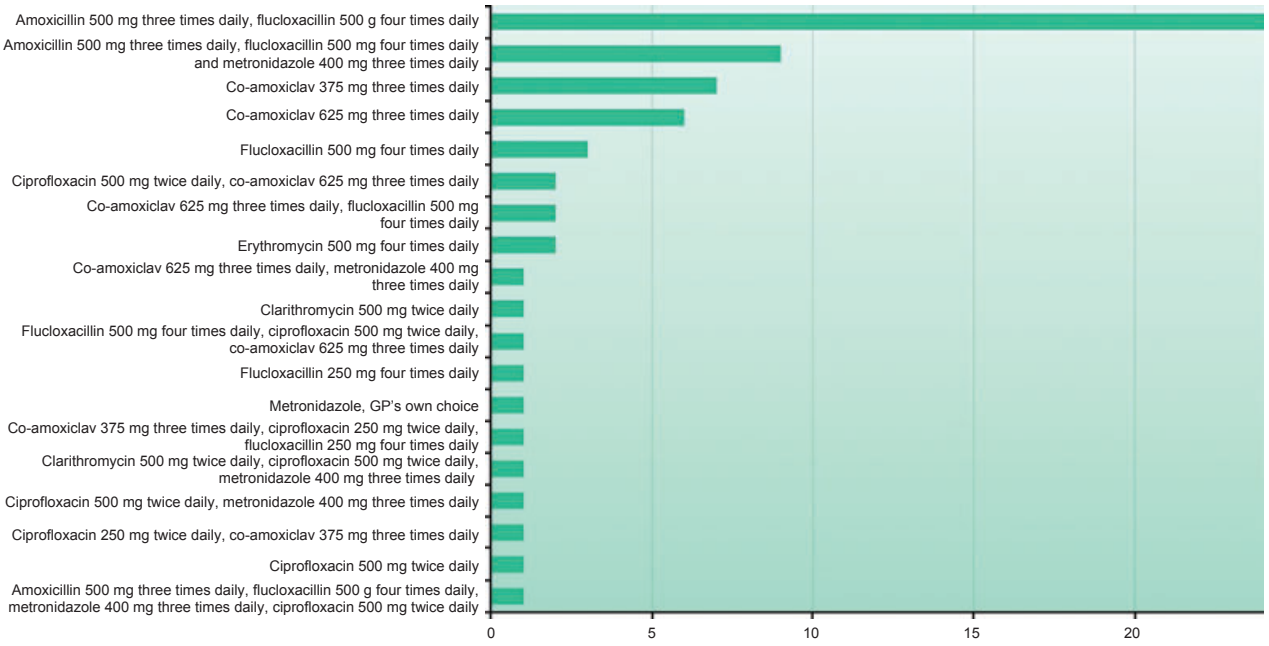

FIGURE 2 The list of antibiotics prescribed prior to the introduction of the dedicated foot formulary for diabetes-related foot infections. The figure shows how frequently individual combinations were prescribed; $n = 64$

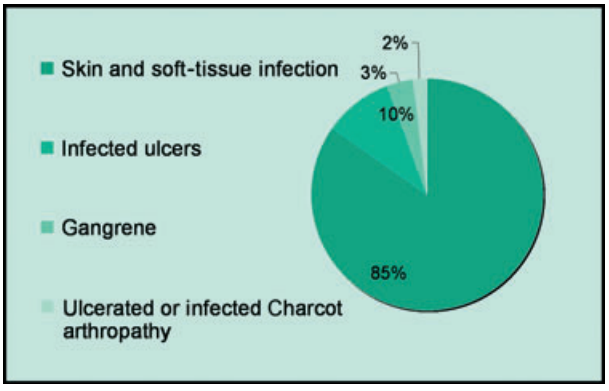

FIGURE 3 The clinical indications for empirical antibiotic prescribing of the patients included in the initial analysis study ($n = 64$)

Based on the 2010 British National Formulary prices, the cost for an overall average 3-week course of these tablets was £16.42. We also found that 86% of the time, prescribing was in accordance to the protocol. As is shown in Fig. 4, four of the eight antibiotic regimens prescribed were not on the protocol. However, these accounted for very few of the overall number of prescriptions dispensed, and were almost all written by non-foot clinic physicians.

For the 80 subjects treated after the introduction of the protocol, we had 93% positive microbiological cultures available for analysis. Five of these cultures grew microorganisms resistant to the antimicrobials prescribed. Three were new cases of methicillin-resistant *S. aureus*.

Intramuscular antibiotics

Our criteria for the revised IDSA classification are shown in Table 2.

Between January 2009 and October 2010 we prescribed intramuscular ceftriaxone, together with oral ciprofloxacin 500 mg twice daily and metronidazole 400 mg three times daily 26 times in 23 individual patients. During this time, there were no reported adverse effects (including injection site reactions) reported to us either from the patients or from primary care staff. The number requiring intramuscular or intravenous treatments are shown in Fig. 5, as are the length of treatment and the lengths of hospital stay for those requiring admission.

All of the patients given intramuscular antibiotics ($n = 26$) were treated according to our guideline. None of the patients treated with the intramuscular and oral regimen grew either methicillin-resistant *S. aureus* or were penicillin allergic. As can be seen in Fig. 5, in 14 episodes, which under the IDSA classification would have warranted hospitalization, admissions were avoided.

The daily cost of the intramuscular and oral antibiotic regimen (ceftriaxone 1 g in 3.5 ml of 1% lidocaine, oral ciprofloxacin 500 mg twice daily and oral metronidazole 400 mg three times daily) based on the 2010 British National Formulary prices was £10.34 per day [8]. The total cost of the intramuscular and oral antibiotics used for those 14 episodes in which admission of the patient was avoided was £6633.48.

The assumption made was that, prior to the introduction of our protocol, these individuals would have been admitted for intravenous antibiotics. If they were to have stayed for

Table 1 The antibiotic foot formulary developed by the multidisciplinary foot teamAUTHOR QUERIES: in Table 1 the abbreviations used have been written in full throughout. Please check that this has been done correctly

	First choice		Penicillin allergy		
	Partial or full thickness	Extending to underlying soft tissue/bone	Partial or full thickness	Extending to underlying soft tissue/bone	Duration
Mild*	Co-amoxiclav 625 mg three times daily orally	Co-amoxiclav 625 mg three times daily orally	Clarithromycin 500 mg twice daily orally	Clarithromycin 500 mg twice daily orally Metronidazole 400 mg three times daily orally	Review after 1–2 weeks. May require an additional 1–2 weeks of treatment See guidance below re LFT monitoring if treatment continues beyond 2 weeks
Moderate*	Co-amoxiclav 625 mg three times daily orally If co-amoxiclav has previously been used with no success then consider using clindamycin 150–300 mg four times daily orally instead	Co-amoxiclav 625 mg three times daily orally ± ciprofloxacin 500 mg twice daily orally. If co-amoxiclav has previously been used with no success then consider using clindamycin 150–300 mg four times daily orally instead of co-amoxiclav	Clindamycin 150–300 mg four times Uily orally	Clindamycin 150–300 mg four times daily orally ± ciprofloxacin 500 mg twice daily orally	2–4 weeks
Moderate infection—borderline admission (this regimen will be reviewed regularly as to whether admission is necessary or can be used to aid early discharge)	Ceftriaxone 1–2 g once daily intramuscularly† (see notes below re intramuscular administration) Ciprofloxacin 500 mg twice daily orally Metronidazole 400 mg three times daily orally If previously MRSA positive, use teicoplanin in place of ceftriaxone		Ceftriaxone 1–2 g once daily intramuscularly† (see notes below re intramuscular administration) Ciprofloxacin 500 mg twice daily orally Metronidazole 400 mg three times daily orally See note below re penicillin allergy. In true penicillin allergy or if MRSA positive use Teicoplanin intramuscularly† 400 mg once daily (see notes below re intramusculcar administration) Ciprofloxacin 500 mg twice daily orally Metronidazole 400 mg three times daily orally		2–4 weeks
Severe—needs admission	Tazocin 4.5 g three times daily intravenously If polymicrobial infection suspected with MRSA, then add in vancomcyin 1 g twice daily intravenously to the above		Clarithromycin 500 mg twice daily intravenously Metronidazole 500 mg three times daily intravenously Ceftazidime 1 g twice daily intravenously (2 g three times daily intravenously if very severe). Substitute with ciprofloxacin 500 mg twice daily in true penicillin allergy If polymicrobial infection suspected with MRSA, then add in vancomcyin 1 g twice daily intravenously to the above regimen (omitting clarithromycin)		2–4 weeks
Osteomyelitis	Co-amoxiclav 625 mg three times daily orally (+ sodium fusidate‡ 500 mg three times daily orally if no evidence of healing after 4 weeks and a sodium fusidate-sensitive *S. aureus*		Clindamycin 300 mg four times daily orally Consider ciprofloxacin 500 mg twice daily + metronidazole 400 mg three times		4–6 weeks

Table 1 (*Continued*)

	First choice				
			Penicillin allergy		
	Partial or full thickness	Extending to underlying soft tissue/bone	Partial or full thickness	Extending to underlying soft tissue/bone	Duration
		identified). Consider ciprofloxacin 500 mg twice daily + metronidazole 400 mg three times daily orally if a gram-negative organism identified or no evidence of improvement after 4 weeks		daily orally if a gram-negative organism identified. or no evidence of improvement after 4 weeks	

*If patient is MRSA positive, then prescribe according to sensitivities (combination of two of the following oral antibiotics, doxycycline, trimethoprim, rifampicin, fusidic acid (but do not use fusidic acid in combination with rifampicin). Discuss with a medical microbiologist if sensitivities not available.
Co-amoxiclav may cause cholestatic jaundice if use is prolonged, especially in patients over 65 years. If treatment continues over 2 weeks, liver function tests (LFT) should be carried out every 2 weeks for the first month and then monthly from then on for the duration of treatment.
Cholestatic jaundice may occur up to 6 weeks after treatment is stopped.
†Intramuscular antibiotics should only be given where there are appropriate facilities available to treat anaphylaxis. Ceftriaxone 2 g intramuscularly should be given as two separate 1-g injections in different sites.
‡Sodium fusidate may cause an elevation of liver function tests. Perform liver function tests at baseline and then every 2 weeks during treatment for the first month. After this time, perform liver function tests according to clinical judgement—minimum requirement is every 4 weeks throughout treatment.
MRSA, methicillin-resistant *Staphylococcus aureus*.

the same average length of time that those who were admitted directly stayed—i.e. 16.11 days—this equated to a saving of 225.54 bed days. In 2010, our institution estimated that the cost of a 24-h stay in a hospital bed was £274. Thus, avoiding admission for those 14 episodes led to a saving of £61 797.96. However, given that the expenditure on antibiotics dispensed in the community was £6633.48, the actual estimated saving was therefore £55 164.48, or £3940.32 per patient per episode.

Furthermore, looking at the outcomes for the 12 patients who had to be admitted despite having been treated with intramuscular and oral antibiotics as outpatients, these individuals were in hospital for an average of 9.25 days (range 2–25), i.e. 6.86 days less than those people who had been admitted directly from foot clinic. This led to a saving of 82.32 bed days (at £274 per day), making an estimated saving of £22 550.68 or £1879.64 per patient.

District (community) and practice nursing time was then factored into the people treated as outpatients. We estimated 1 h per day at a cost of £16 per h. Thus, for the 26 people treated with intramuscular and oral antibiotics at a cost of £10.74 per day, we avoided or reduced hospital admission by 307.86 days [(14 × 16.11) + (12 × 6.86)]. The total thus spent on antibiotics and nurse time was £3306.42 + £4925.76 = £8232.18. The costs avoided from hospital admission were £274 × 307.86 = £84 353.64. This does not include the costs of intravenous antibiotics. Thus, in these 26 episodes, we estimate a saving of £76 121.46. This is likely to be an underestimate.

The long-term outcomes for those individuals followed up over the next 12 months are shown in Table 3.

Discussion

We have presented data to show that rationalizing our empirical antibiotic protocol for the management of foot infections in people with diabetes has led to costs savings. In addition, we have also shown that, by modifying the IDSA guideline to include a section that allowed for the outpatient administration of empirical treatment with intramuscular and oral antibiotics, over 50% of people given this combination avoided hospital admission. Furthermore, for those who did require admission despite having initial treatment with intramuscular and oral antibiotics, their admission was significantly shorter than those admitted directly from clinic.

There are many other factors that influence the choice of an empirical antimicrobial agent and complicate the development of a protocol. High-profile guidelines have been produced over the last few years, but these have been limited by being consensus documents in their level of evidence [7,11,12]. In addition, these guidelines are often limited to recommending the use of oral or intravenous administration only. The National Institute for Health and Clinical Excellence recommends that each hospital should have an antibiotic guideline for the management of diabetes-related foot infections [7]. The

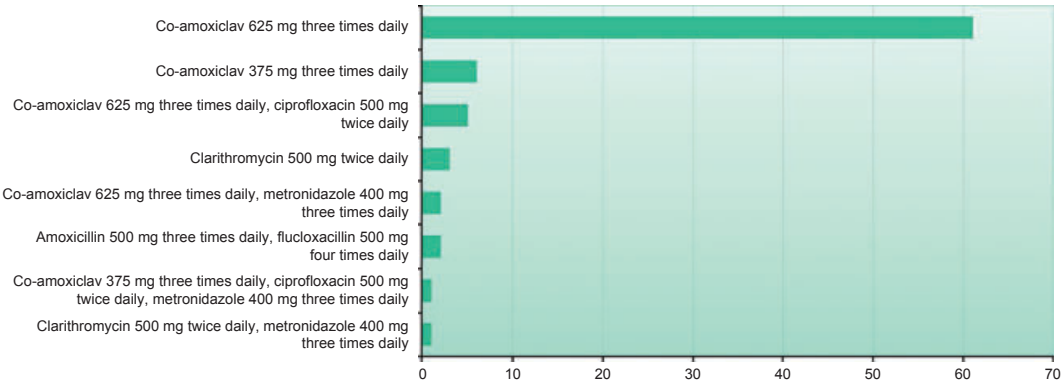

FIGURE 4 The list of antibiotics prescribed following the introduction of the dedicated foot formulary for diabetes-related foot infections. The figure shows how frequently individual combinations were prescribed; $n = 80$. Fourteen per cent of the least frequently prescribed combinations were not on the protocol and were issued by medical staff not familiar with foot clinic processes. The 375 mg three times daily prescription for co-amoxiclav was for those with renal impairment

Table 2 The classification developed by the authors, based on the Infectious Disease Society of America (IDSA) model, but including the extra category of 'moderate infection—borderline admission'

Clinical manifestations of infection	Infection severity
No purulence or evidence of inflammation	Uninfected
Evidence of inflammation $\leq$ 2 cm around the ulcer	Mild
Cellulitis > 2 cm around the ulcer	Moderate
Cellulitis > 2 cm around the ulcer associated with lymphangitis or foot failing to respond to oral antibiotics alone and not systemically unwell	Moderate infection—borderline admission
Cellulitis as well as evidence of systemic toxicity (fever, hypotension, leukocytosis) or abscess formation, infection tracking beneath fascia, foot not responding to oral or intramuscular antibiotics or wet gangrene	Severe—admission

specific guidelines for the treatment of diabetes-related foot infections, published by the International Working Group on the Diabetic Foot (IWGDF), conclude that the available data about the effectiveness of interventions in the management of diabetes-related foot infections do not favour any particular antibiotic treatment strategy; i.e. specific antibiotic class or agent, route or duration of therapy [13]. The IWGDF commented that there was little evidence to support decisions on the cost-effectiveness of various antibiotic regimens. Thus, a recent systematic review of the literature surrounding the evidence base for interventions in diabetes-related foot infections concluded that 'more robust, well-designed, comparative trials' were needed [14].

Prior to the introduction of our antibiotic protocol, it had previously been necessary to admit those people who had infections falling in the 'moderate infection—borderline admission' category. As has been recently shown, the treatment of diabetes-related foot problems is expensive—accounting for up to 0.67% of the entire National Health Service (NHS) budget [4]. Thus, strategies to avoid hospital admission would help to reduce costs. Almost no previous discussions or guidelines on the treatment of infections of foot wounds in people with diabetes addresses the issue of admissions avoidance.

Issues not explicitly considered by the IWGDF or the IDSA were the ease of drug administration, in particular using combinations that would encourage patient compliance, or the use of outpatient treatment strategies, avoiding hospital admission where possible. During protocol development, we took into account the lack of primary care facilities or staff trained to use or maintain intravenous access. Thus, we devised an option to use intramuscular ceftriaxone 1 g in 3.5 ml of 1% lidocaine given once daily, in addition to ciprofloxacin 500 mg twice daily and metronidazole 400 mg three times daily and twice-weekly outpatient evaluation in our foot clinic. In individuals who were penicillin allergic, intramuscular teicoplanin 400 mg once daily was used in place of ceftriaxone. This empirical regimen could be easily administered by district nurses or practice nurses in primary care on a daily basis.

The decisions to move from intramuscular to either oral treatment (if there has been an improvement) or the decision to admit (if the infection had deteriorated) was based on clinical grounds. This was dependent on the clinical state of the patient and the wound. Because of the set-up of the foot clinic, the number of people who reviewed the wound and made the decision to change (or continue) therapy was very small, usually limited to authors CG or KD. This allowed for consistency of evaluation. The relatively shorter time that people were on intramuscular treatment before moving to intravenous treatment showed that it became quickly apparent that intramuscular treatment was not working, and that they needed admission. However, the time on the intramuscular antibiotics led to a significantly shorter mean length of stay in hospital on intravenous treatment.

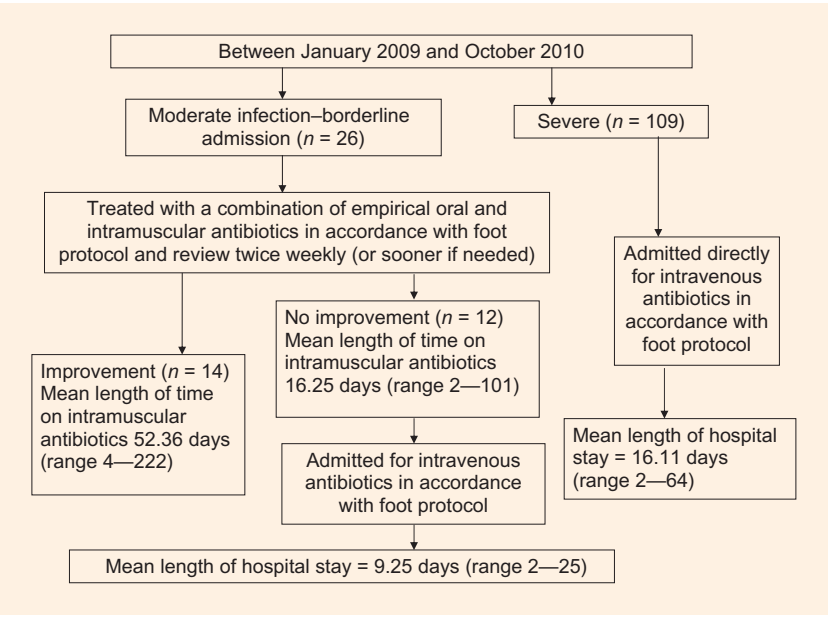

FIGURE 5 This shows how many people were treated in each group and for how long they needed treatment.

Table 3 The outcomes at 12 months of those treated with either intramuscular antibiotics alone, or those who started with intramuscular antibiotics who had to be admitted for intravenous treatment

	Intramuscular antibiotics n = 14	Intramuscular and intravenous antibiotics n = 12
Healed	9	3
Surgical debridement—healed	1	3
Orthopaedic surgery—healed	1	0
Minor amputation—healed	0	1
Major amputation	1	3
Not healed	1	1
Died/lost to follow-up	1	1

On subsequent microbiological analysis of cultures, there was a lack of data on organisms identified to show that our choice of empirical treatment was correct. However, given that over 50% got better without admission, this suggests that they were given the correct agents. In addition, for those individuals for whom microbiological results were available, no patients had their antibiotics changed. Only those 12 people who went on to require hospital admission for intravenous antibiotics had their antibiotics changed.

In our analysis we allocated 1 h of practice or district nurse time to administer the intramuscular antibiotic. This may have been rather generous. For most patients, the injection was given by their own practice nurse between Monday and Friday, thus the nurse was already 'on site' and the time taken to check, draw up and administer the drug is likely to have been less than half of this time. The time taken by the district nurses (who administered the drugs at weekends), may have been over an hour when travelling time was included.

One of the strengths of our guideline is that it laid down explicitly what antibiotics to use with varying degrees of infection. This allowed for standardization of assessment for changes in the severity of the wound and the subsequent interventions needed. This also improved consistency of patient treatment and experience. Staff and patients became familiar with the regimens and expectations around them. Another strength of the protocol was that we laid down a specified duration of treatment before deciding whether to prescribe more antibiotics. This is something that many guidelines have lacked.

Furthermore, we were able to identify all patients with diabetes admitted to hospital with foot problems from our foot clinic and follow their progress. Our data do not include the costs associated with intravenous antibiotic treatment—these are assumed to be included in the 'hotel bed day' costs—and thus the actual savings made are likely to be higher. In addition, we were able to follow all patients on the intramuscular regimen closely because they all were required to have their antibiotics prescribed and issued by the specialist diabetes foot clinic.

There are some limitations to our data. We collected data on relatively small numbers of patients. Despite this, there are very few data in the literature that examine the use of intramuscular antibiotics, and thus we feel that to present this data set may be valuable. The vast majority of the

patients seen at our clinic were no longer under our care, and thus these data are limited to those people who were still under the active care of the foot clinic—in particular those patients who presented with a new infected foot lesion and who had not been on any antibiotics before they were seen by us.

The data on costs have been estimated from those quoted in the British National Formulary and may not be applicable to the National Health Service in general because many hospitals may get 'discounts' on bulk purchases from suppliers. It may have been better to calculate them using the drug tariff. A further limitation may be attributable to the estimation of the length of the course of antibiotics. However, given that the costs using the protocol were marginally cheaper, it is likely that, if prolonged courses were used, the cost savings would have been greater. Another limitation when discussing the use of intramuscular antibiotics was that those people who were admitted directly from our foot clinic had, by definition, more severe disease. Thus, is may be assumed that, because of this, they would have stayed in hospital longer than those who had a lesser degree of infection (albeit one that prior to the introduction of the protocol would also have led to admission). We also did not include those people who may have been admitted directly from other clinics—for example, vascular or orthopaedic. However, members of our foot multidisciplinary team communicate almost daily, ensuring any patient with diabetes admitted to our institution with a diabetes-related foot problem is seen by a member of the foot multidisciplinary team within 24 h of admission.

Our intramuscular antibiotics were required to be prescribed by the hospital, even although they were administered in primary care. There were two main reasons for this. Firstly, with the agreement of primary care, they believed that the degree of infection warranted regular secondary care assessments of the wound, thus people on the intramuscular regimen were reviewed at least twice per week. Secondly, primary care prescribing advisors considered that this antibiotic was very uncommonly used in primary care, and thus its use should remain under secondary care supervision. Importantly, many of our patients were able to keep doing their jobs whilst receiving their treatment, thus reducing the economic impact to themselves and society as a whole.

In summary, we have introduced a new standardized initial empirical antibiotic policy that has modified the IDSA guideline. We found that, by collaborating within the multidisciplinary diabetes foot clinic team, we rationalized the prescribing of antimicrobials at no additional drug cost. This rationalization has meant that the cost of treatment has stayed relatively unchanged. At the same time, we have also simplified the regimens in an attempt to improve patient compliance.

Our policy advocated the use of an intramuscular and oral antibiotic administration regimen. This regimen saved over £60 000 in just 23 patients over a period of 22 months. Whilst we believe that this is a cost-effective strategy for admission avoidance, longer-term studies are needed to confirm this.

Funding sources

None.

Competing interests

None declared.

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