Antibiotic prescribing for the older adult: beliefs and practices in primary care

Hayward G[1*], Moore A[1], Mckelvie S[1], Lasserson D[2], Croxson C[1]

1. Nuffield Department of Primary Care Health Sciences, University of Oxford, Radcliffe Observatory Quarter, Woodstock Road, Oxford, England, OX2 6GG
2. Institute of Applied Health Research, College of Medical and Dental Sciences, University of Birmingham, England, B15 2TT

Corresponding author:

Dr Gail Hayward

Email: gail.hayward@phc.ox.ac.uk

Telephone: 01865 289357

Running title:

Antibiotic prescribing for the older adult: GP beliefs

Abstract

Background: Older adults suffer high morbidity and mortality following serious infections, which are increasing in prevalence. Antibiotic prescribing in the older adult population, especially in long term care facilities, has been argued to be inappropriately high. In order to develop the evidence base and provide support to General Practitioners (GPs) in achieving antimicrobial stewardship in older adults it is important to understand their attitudes and beliefs toward antibiotic prescribing in this population.

Objectives: To understand the attitudes and beliefs held by GPs regarding antibiotic prescribing in older adults

Methods: Semi-structured qualitative interviews were conducted with 28 GPs working in the UK. Data analysis followed a modified framework approach.

Results: GPs described antibiotic prescribing differing in older adults in a number of ways, including prescribing broad spectrum, longer and earlier antibiotics in this population. There were also rationales for situations where antibiotics were prescribed despite there being no clear diagnosis of infection. Trials of antibiotics were used both as diagnostic aids and in an attempt to avoid admission. The risks of antibiotics were understood, but in some cases thought to hamper optimal management of infection in this age group.

Conclusions: Diagnosing serious infection in older adults is challenging, and antibiotic prescribing practices reflect this challenge, but also reflect an absence of clear guidance or evidence. Research which can fill the gaps in the evidence base is required in order to support GPs with their critical antimicrobial stewardship role in this population.

Introduction

Primary care manages 90% of patient contacts in the NHS[1] and is responsible for 80% of antibiotic prescribing.[2] Increasing antibiotic use is associated with antimicrobial resistance (AMR) at an individual and population level[3 4] in addition to complications such as *C.difficile* infections, nephrotoxicity, drug interactions and side effects.

Older adults commonly present with symptoms compatible with acute infection; admissions with pneumonia and urinary tract infections have increased significantly over the last 15 years.[5 6] Compared to younger people, they have a greater risk of mortality and morbidity after serious infection. The prevalence of AMR is higher in long term care facilities than in the community,[7 8] and it has been estimated that up to 50% of antibiotic prescriptions are inappropriate in these settings.[9] Long term care facilities have been argued to act as 'reservoirs of resistance' in the community.[10 11]

The majority of antibiotic prescriptions are driven by symptoms and signs in the community, with only two point of care diagnostic tests available; urine dipsticks which have relatively poor sensitivity and specificity,[12] and C-reactive protein (CRP), which has a number of barriers to implementation, not least that it is currently too expensive for the majority of practices to purchase.[13] There are also no diagnostic algorithms for infection which have been validated in primary care settings for older adults.

A key precursor to targeted prescribing and reducing unnecessary antibiotic prescriptions for older adults is to understand what drives prescribing behaviour in primary care for this population. Although previous work has explored beliefs around antibiotic prescribing in out-of-hours primary care,[14] paediatric populations (eg [15-17]), and in hospital settings[18 19] there is an absence of evidence focussing on older adults in the community. In order to understand why General Practitioners (GPs) make decisions to prescribe antibiotics in this population we need to explore the range of attitudes and beliefs of GPs in a clinical area where high quality evidence is lacking.

This paper presents data on GPs' beliefs about antibiotic prescribing in older adults. It is part of a larger qualitative interview study with GPs which explored diagnosis and management of serious infection in older adults in primary care.

Methods

Recruitment

NHS GPs were recruited from across the UK by an email advertisement sent via Clinical Commissioning Groups, Royal College of General Practitioners and RuralGP.com mailing lists. GPs were sampled purposively to achieve maximum variation in their experience, role, practice location and practice size. Recruitment continued until the research team agreed data saturation had been reached (no new codes or themes had emerged for several consecutive interviews).

Data collection

Interviews were carried out face to face (4) or over the telephone (24), according to participant preference, from April 2015 to February 2016. All participants gave written or recorded verbal informed consent prior to the interview.

Interviews were conducted separately by two researchers both trained in qualitative methods; GH (a female clinical lecturer and salaried GP) and AM (a female academic clinical fellow and GP trainee). Continuity was ensured by regular discussion between researchers and checking between transcripts.

Interviews were semi-structured following a flexible topic guide developed and pilot tested by the research team. The topic guide was informed by literature on factors affecting GP decision making[20-22] and the expertise of the research team. The topic guide evolved during the study period based on

team discussions of emerging themes. In particular antibiotic prescribing was noted as a theme which was important to some of the first GPs interviewed and was incorporated into the topic guide to ensure it was consistently discussed.

Participants were also asked to think about recent or memorable cases where they either diagnosed or missed a diagnosis of infection in an older patient to discuss during the interview. An age cut-off of >70 years was given to encourage discussion of a predominantly older, frailer population.

Interviews lasted 30-40 minutes on average. Interviews were audio-recorded, transcribed verbatim by a transcription company and checked against the original recording by the research team.

The study was approved by the University of Oxford Medical Sciences Interdivisional Research Ethics Committee (Ref no: MS-IDREC-C1-2015-054).

Data analysis

Data analysis followed a modified framework approach.[23] Key steps were transcription, familiarisation with the data, coding, developing and applying an analytical framework, and interpretation. An initial coding framework was created based on the topic guide and content of the interviews through double coding of the first 4 transcripts. Data were then coded and checked by 2 researchers, with the assistance of NVivo (version 10). The coding framework and themes were developed in discussion amongst the whole research team. Here, the data relating to antibiotic prescribing are presented.

Results

Of the 38 GPs who responded initially to advertisements 28 consented to take part in the study and were interviewed to achieve a maximum variation sample. The characteristics of participants are described in Table 1. Cases discussed commonly included chest infection, urine infection, cellulitis or infection of unknown source. Rarer diagnoses such as discitis, appendicitis, joint infection, gastrointestinal infection and candidiasis were also included.

The themes to emerge from the data are presented in Table 2 and will be discussed below.

Ways in which prescribing differs for older adults with suspected infection

GPs described a number of ways in which their approach to prescribing antibiotics differed in older compared to younger patients. A common practice was the **use of broad spectrum antibiotics when the location of the infection was unclear**. This would allow both lower respiratory and urinary tract infections to be treated with the same agent, where the GP was unable to elicit any classic signs of infection at either site.

"It can be difficult, sometimes making diagnosis like you'll go round, they'll be someone feverish and not well who have got an infection somewhere but you know, they've got a poor respiratory effort so you can't really do a thorough chest examination because you can't hear that much. They're not able to do a urine sample because they're incontinent…..they've clearly got an infection but you don't know where it is in which you then go for a best guess, it could be the chest, it could be urine, you can't tell between the two. It's unlikely I'm going to be able to prove it between the two but I'll give them an antibiotic that will cover for both, see if they improve". (GP7 - male locum / salaried GP, 1-5 years experience, mixed (both rural and urban) population)

This was sometimes justified on the basis of a belief that this was a strategy likely to result in avoidance of hospital admission.

" I did, what I sometimes do in this age group who, I didn't offer her admission, actually, I thought, I said, "Well, let's cover you with some broad spectrum antibiotics, send off another urine and then see how you go tomorrow, if need be."(GP11 - female salaried GP, 11-15 years experience, rural population)

Some GPs reported that this approach was also advocated by doctors working in secondary care whose advice they sought.

"I spoke to the Acute GP Unit, which is how we admit people locally, and they weren't very keen on her being admitted either, despite it being Friday. So, they suggested starting her on antibiotics and starting her on Cipro because it would cover both her chest and the UTI and taking some bloods" (GP25 - female partner 1-5 years experience, suburban population)

GPs also expressed the belief that **early administration of antibiotics could reduce the chances of admission** with infections

"If you can treat early with Augmentin on the odd occasion in the community you can prevent hospital admission and it's a very good medication. And if you were to go into hospital they're more likely to get your superbugs and whatever so it's a balancing act…even though strictly speaking for younger patients you might be thinking for a urine infection we'll try Trimethoprim, well that's fair enough but somebody septic and unwell and it could be their chest, you're not 100% then providing a broad spectrum antibiotic for them early, you know, for a week or five days to a week is probably on balance to my mind the best thing to do." (GP3 - female partner, 11-15 years experience, mixed population)

GPs with a range of experience expressed the belief that **longer courses of antibiotics are needed in older patients,** although this view was not universally held, with some GPs describing adhering strictly to guidelines. Underlying this belief in some cases was an understanding of the likely pathological changes with age which could ensure persistence of bacterial infection

"There's part of me that feels they, you know, they should have a longer course, simply 'cos their lung... this particularly... not necessarily the elderly, I don't know about that, but I'm more thinking about COPD and how there's all these sort of pockets of goo everywhere that you need to expose them to the antibiotics for longer to have some chance of clearing it, but probably they never get into these places anyway, so I probably do tend to give longer courses of antibiotics to older people." (GP17 - male partner >21 years experience, urban population)

"Well, they generally don't mount quite as good an immune response, so potentially yes they do, … well for a UTI I will always prescribe an elderly patient a 7-day course instead of a 3-day course." (GP25 - female partner,1-5 years experience, suburban population)

Intravenous (IV) antibiotics were often believed to be required for patients who appeared 'unwell' with infection, who had more rapid onset or severe symptoms, evidence of progression of infection, or had comorbidities which could enhance the risk of complications. There were some presentations that were felt to be unlikely to resolve with oral antibiotics alone.

"Anyway, so I gave her some Flucloxacillin, treated that, said to her 'give me a ring if it doesn't get better', so in fact she didn't give me a ring, she actually came in again, and she looked decidedly unwell and the cellulitis had really taken up most of her arm oddly and she was clearly pyrexial and unwell and sort of toxic, and I'd sort of, I just felt she needed IV antibiotics which is why I sent her in, and she

did, well that's what they gave her, so she went in for IVs." (GP13 - female partner, >21 years experience, mixed population)

In a number of cases, GPs felt that in addition to IV therapy, hospital admission would be beneficial due to the more general care needs of the patient.

"My view is, what's a hospital going to provide different to keeping this person at home? So that might be nursing care or it might intravenous antibiotics." (*GP11 - female salaried GP, 11-15 years experience, rural population)*

However in contrast some GPs with a range of experience felt that there were limited benefits associated with a hospital admission for IV therapy. Cellulitis was highlighted as a condition where admission was less beneficial.

"Yeah, I suppose something like, for example, the one where I tried a second line antibiotic, often I kind find myself thinking well if they went to hospital, as well as the investigations which will kind of add to what we already know and what we're already treating for, you know, if they can tolerate antibiotics by mouth it's often possibly not a lot more that they're going to get in hospital." (GP5 - female salaried 1-5 years experience, mixed population)

"…certainly cellulitis is something where, you know, you're not winning after 48 hours of oral antibiotics, they only need to go onto IVs, they're not septic septic." (GP24 - male partner >21 years experience, suburban population)

Rationale for prescribing antibiotics when the GP was not certain that infection was the cause of the symptoms

In the setting of limited medical history and diagnostic uncertainty over a generalised acute deterioration which typified many of the elderly patient contacts described by GPs, an increased likelihood of prescribing antibiotics was described in certain contexts. A key example was when the **patient was perceived to be at higher risk of deterioration or death** should the presenting symptoms be due to infection, either because of co-morbidities or purely due to older age.

"Sometimes it's not the worst thing in the world to treat elderly people with antibiotics just because of their co-morbidities because they're more at risk of being admitted to hospital and adverse outcomes if you don't, where with a young person if you don't treat their chest infection with antibiotic the chances are they're going to get better regardless, even if it is a bacterial infection."(GP3 - female partner, 11-15 years experience. mixed population)

A second context in which GPs frequently described prescribing antibiotics despite being uncertain that infection was present was a patient and family preference for avoiding hospital admission and a **ceiling of care of community based management**. In this context antibiotics were seen as an alternative to doing nothing to try and reverse a deterioration despite little objective evidence of infection.

"the family were still wanting her to be for active treatment but were saying if it could be managed in the community they would prefer that, so we agreed to give her 24 hours of Co-amoxiclav to cover for chest and urine, even though there was nothing obvious to hear in the chest and just see what happened." (GP27 - female partner, 6-10 years experience, urban population)

"this was somebody who'd made acute deterioration, we weren't going to be admitting him to hospital, we had to see what we could do within the environment, to see what we could do to improve him. He was able to take oral antibiotics, oral suspension, and I thought that was something

that we could do that might actually improve him clinically, or make some improvement" (GP1- female partner, >21 years experience, mixed population)

Some GPs described cases where antibiotic treatment was not closely linked to recovery, and in hindsight considered that another process may have underpinned the deterioration

"She'd had a positive urine dipstick and she was just a bit more agitated than normal so prescribed some antibiotics although I didn't see her, I think they had observations which were normal and she sounded okay so prescribed antibiotics over the phone and asking them to send a culture. And then she didn't really, didn't sort of get better after that but a repeat dipstick was negative and she just sort of got better over time really and I think it was actually just her Alzheimer's, a phase of her Alzheimer's rather than, probably rather than an infection." (GP4- male salaried / locum 1-5 years experience, mixed population)

Approaches to using courses of oral antibiotics as a trial of treatment

GPs described using antibiotics **as a trial of treatment both as a precursor to IV antibiotics, and** in an attempt to resolve diagnostic uncertainty, with a variety of practices described. GPs described a need to **demonstrate that a trial of oral antibiotics had failed** before requesting admission for IV therapy from a secondary care provider.

"So the diagnosis was slightly unclear so she ended up starting on high dose oral Fluclox, having some Heparin before she left and going up to the DVT clinic the next day. At that point I didn't admit her because she hadn't had a trial of oral antibiotics and was relatively well."(GP27 - female partner, 6-10 years experience, urban population)

In particular the duration of a trial of treatment varied widely. A number of GPs used a time period of 24 – 48 hours to wait before conducting a clinical review. A variety of reasons were given for this including concern that the patient would not call back if they became less well, and concern from relatives. Other GPs described using the duration of the antibiotic course as a guide for the review, or the review period varying depending on the proximity to the weekend

"well look, shall we try these antibiotics but if she's no better in 24 to 48 hours and if she definitely, if she gets worse in that time we're definitely admitting her'. (GP25 - female partner, 1-5 years experience, suburban population)

GPs also gave different descriptions of a clinical status which would indicate failure of oral antibiotics, ranging from a lack of clear improvement, (i.e the patient not feeling better, as in the quote above) to a significant clinical deterioration. Persistence or new emergence of fever was also an important feature for some GPs in determining whether a trial of antibiotic had been effective.

Actions taken if initial course of antibiotics does not resolve the symptoms

GPs described a number of approaches taken once a failure of initial oral antibiotic treatment became apparent in older patients. These included changing the antibiotic to a broader spectrum oral option, continuing the course for longer, increasing the dose, referring to a community service for IV antibiotics or admission to hospital. In cases where referral was not considered acceptable this could lead to multiple courses of antibiotics, something particularly described for cases of cellulitis. However, as discussed further below, a number of GPs also highlighted their awareness of the need for antimicrobial stewardship.

"we often change the antibiotics three times, or, say, they start off with Fluclox then they might go to Clindamycin, sometimes have clarithromycin in the meantime, and, I think, if nothing works, then we send them in." (GP11 - female salaried GP, 11-15 years experience, rural population)

"…and he suggested she probably ought to be admitted but she didn't want to be so he doubled up the Fluclox for couple of doses and said, 'see how things go and if things are no better come back tomorrow.'" (GP27 - female partner, 6-10 years experience, urban population)

Risks of antibiotic prescribing

GPs alluded to a number of risks associated with antibiotic prescribing. ***Clostridium difficile* infections** required a careful balancing act between the need for antibiotics for other infections and the need to avoid recurrence.

"..we've given her pivmecillinam and taken a guess as to what's not going to cause her to have C.diff again but also balance with something that's effective." (GP3 - female partner, 11-15 years experience, mixed population)

One experienced GP expressed concern that the risk of *C difficile* infection was resulting in over caution in prescribing

"I know the rationale behind it is about clostridium difficile but nevertheless there is a detraction in some of the restrictions that we have to our prescribing, which makes it you <u>may</u>, you sometimes may not actually give patients or try antibiotics that otherwise might have worked."(GP13 - female partner, >21 years experience, mixed population)

Antimicrobial resistance was another key risk highlighted, although the difficulty in deciding not to prescribe was acknowledged, for example in the OOH setting.

"Well, I suppose there's always contemporaneous, the issue of antibiotic resistance, and I think, you know, particularly when you're in out-of-hours and you have to put on one of the safest possible caps, it's much more difficult to take risks when you don't know the patients, you don't know their backgrounds, you're much more likely to lean towards antibiotics…" (GP22- male OOH GP, 6-10 years experience, urban population)

The need to triangulate decision making with microbiology and indeed challenge the diagnosis if there was no improvement with antibiotics was discussed, which contrasted with the practice of prescribing multiple courses of oral antibiotics to infections which were not resolving, as described above.

"I think a lot of that multiple courses of antibiotic is because people don't engage their brains enough. They'll think, "Oh you know, UTI, Trimethoprim," leaving aside the fact that it, you know, it doesn't work in a quarter of people on average, and actually in this particular person, they've had multiple courses of the stuff. So I think if you're being more cogent, then you can probably reduce that risk a bit." (GP26 - male OOH GP, 6-10 years experience, mixed population)

However in some participants, just like C difficile, the concerns over the risks of AMR were believed to hamper appropriate management in older people.

"*We've got a whole raft of antibiotics, four of them in fact, which we're not supposed, well, we're asked not to prescribe, and they monitor our prescribing on the Cephalosporins, and Co-amoxiclav etc, and …. part of me thinks 'actually you probably would have done well by having Co-amoxiclav, a decent dose of it', but then we're monitored on it and then we get these, you know, notifications*

from the CCG saying 'oh your prescribing's more than this' and there are financial penalties." (GP13-female partner, >21 years experience, mixed population)

"*I would actually probably give Clarithromycin because that is likely to cover both a UTI and a chest infection, and our LHB at the moment is auditing all GPs and saying that GPs should not under any circumstances be using Cipro or Augmentin, actually no that's wrong, unless there are sensitivities back showing that they're sensitive to Cipro or Augmentin you shouldn't use them…" (GP25 - female partner, 1-5 years experience, suburban population)*

Discussion

Summary

GPs face a number of challenges and balance a range of different patient and social elements when deciding to prescribe antibiotics for older adults. Antibiotics are prescribed for clear signs of infection, but also in the context of an acute deterioration without a clear infective source. Oral antibiotics are used both as a diagnostic trial and as an attempt to reverse a deterioration in those where hospital admission is inappropriate. When oral antibiotics fail to resolve the symptoms, IV antibiotics are felt to be more justified, but other approaches include changing the drug, the dose or duration. Whilst the requirement for antibiotic stewardship is acknowledged, a tension was evident in that broad spectrum antibiotics are seen as beneficial for treating multiple potential sources of infection and for ensuring more rapid or effective resolution in patients who are seen as higher risk of deterioration and admission with infection.

Strengths and limitations

To our knowledge this is the first study to explore beliefs and practices governing prescription of antibiotics in older adults in primary care. A wide range of GPs were interviewed in terms of

356 experience, role and location of practice. Using a case based approach supported both specific and
357 general discussion of antibiotic prescribing practices. As with all qualitative research our interviews
358 were restricted to those GPs who agreed to participate, which may have been a group who were
359 more interested in and knowledgeable about serious infection in the older adult. However, a range
360 of perspectives were revealed, and participants were selected to be as diverse as possible.

361

362 Comparison with other literature

363 A striking range of beliefs and practices were described in our study with respect to trial of antibiotic
364 treatment. A variety of criteria were used to judge that antibiotic treatment had failed; in some
365 cases this was linked to fever, and in others a general deterioration despite antibiotics. A study
366 which specifically focussed on antibiotic treatment failures in primary care[24] concluded that "Most
367 GPs argued that in practice it is almost impossible to verify if treatment failure actually occurred or
368 not and they generally considered antibiotic treatment failures to be unavoidable in primary care"
369

370 IV antibiotics were deemed necessary if the patient was systematically unwell; they were felt to be
371 able to offer a cure well beyond what oral antibiotics could achieve. Unsurprisingly this was also a
372 belief found to be held by hospital doctors in a study exploring their beliefs concerning de-escalating
373 patients from IV to oral antibiotics.[18] In this hospital doctor population, IV antibiotics were perceived
374 as more potent and having significant 'mythical' qualities, which participants acknowledged were
375 not necessarily evidence based.

376

377 Implications for research and practice

378 This study highlighted a number of evidence gaps regarding optimal prescribing practice for
379 antibiotics in older adults. The lack of specific guidance on duration of antibiotic courses and how

long a trial of oral treatment should be before improvement could be expected, and indeed what would constitute improvement, was evident in the wide range of practices described.

There was also a desire for better understanding of how to judge the likely prognosis of infection in the context of co-morbidities, given the anxieties expressed about deterioration without early, or IV, antibiotics. The best approach to managing patients at high risk of *C. difficile* infection was also unclear and a source of challenging management decisions. Finally there was a need for better ways to distinguish those patients where IV therapy is needed, especially given the uncertainty over the superiority of IV over oral antibiotics in hospital settings.[25 26] If indeed IV antibiotics are associated with better prognosis, this would challenge the belief reported by a number of GPs that IV antibiotics should only be considered once oral antibiotics have failed to demonstrate an improvement.

This study reveals the challenges in managing the frail older patient with deterioration with no clear infection in the community; GPs described using antibiotics in order to try *something* given that a decision had been made to avoid admission. Research to support GPs to better identify those patients where an antibiotic is likely to improve prognosis is clearly needed, and could include evaluation of point of care tests or studies which develop our understanding of the phasic nature of deterioration in function in dementia. An improved understanding of patient and carer expectations is also important; in other prescribing contexts qualitative research has demonstrated that GPs can often be at cross- purposes with family members regarding expectations of antibiotics.[27]

Conclusion

Diagnosing serious infection in the older adult is challenging, and antibiotic prescribing practices reflect this challenge, but also reflect an absence of clear guidance or evidence. Research which can

fill the gaps in the evidence base is required in order to support GPs with their critical antimicrobial stewardship role in this population.

Acknowledgements

nil

Funding

This research was funded by the Scientific Foundation Board of the Royal College of General Practitioners (Grant 2014-14). SM is funded by the National Institute for Health Research (NIHR) Collaboration for Leadership in Applied Health Research and Care Oxford at Oxford Health NHS Foundation Trust. AM is funded by an NIHR Academic Clinical Fellowship and GH is funded by an NIHR Academic Clinical Lectureship. The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

Transparency declarations

None to declare

References

1. Gregory S. General Practice in England: An overview. The King's Fund, 2009. https://www.kingsfund.org.uk/sites/default/files/general-practice-in-england-overview-sarah-gregory-kings-fund-september-2009.pdf

2. Health Matters: antimicrobial resistance. Public Health England, 2015. https://www.gov.uk/government/publications/health-matters-antimicrobial-resistance
3. Costelloe C, Metcalfe C, Lovering A, et al. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. *BMJ* 2010;**340**:c2096.
4. Goossens H, Ferech M, Vander Stichele R, et al. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. *Lancet* 2005;**365**:579-87.
5. Millett ER, Quint JK, Smeeth L, et al. Incidence of community-acquired lower respiratory tract infections and pneumonia among older adults in the United Kingdom: a population-based study. *PLoS One* 2013;**8**:e75131.
6. Wittenberg R SL, McCormack B, Hurst J. Understanding emergency hospital admissions of older people: Centre for Health Service Economics and Organisation, 2014.
7. Mathei C, Niclaes L, Suetens C, et al. Infections in residents of nursing homes. *Infect Dis Clin North Am* 2007;**21**:761-72, ix.
8. Moro ML, Gagliotti C. Antimicrobial resistance and stewardship in long-term care settings. *Future Microbiol* 2013;**8**:1011-25.
9. Dyar OJ, Pagani L, Pulcini C. Strategies and challenges of antimicrobial stewardship in long-term care facilities. *Clin Microbiol Infect* 2015;**21**:10-9.
10. Bradley SF. Methicillin-resistant Staphylococcus aureus in nursing homes. Epidemiology, prevention and management. *Drugs Aging* 1997;**10**:185-98.
11. Bradley SF. Issues in the management of resistant bacteria in long-term-care facilities. *Infect Control Hosp Epidemiol* 1999;**20**:362-6.
12. Little P, Turner S, Rumsby K, et al. Validating the prediction of lower urinary tract infection in primary care: sensitivity and specificity of urinary dipsticks and clinical scores in women. *Br J Gen Pract* 2010;**60**:495-500.
13. Huddy JR, Ni MZ, Barlow J, et al. Point-of-care C reactive protein for the diagnosis of lower respiratory tract infection in NHS primary care: a qualitative study of barriers and facilitators to adoption. *BMJ Open* 2016;**6**:e009959.
14. Williams SJ, Halls AV, Tonkin-Crine S, et al. General practitioner and nurse prescriber experiences of prescribing antibiotics for respiratory tract infections in UK primary care out-of-hours services (the UNITE study). *J Antimicrob Chemother* 2017; **73**:795-803
15. Ashdown HF, Raisanen U, Wang K, et al. Prescribing antibiotics to 'at-risk' children with influenza-like illness in primary care: qualitative study. *BMJ Open* 2016;**6**:e011497.
16. Cabral C, Lucas PJ, Ingram J, et al. "It's safer to ..." parent consulting and clinician antibiotic prescribing decisions for children with respiratory tract infections: An analysis across four qualitative studies. *Soc Sci Med* 2015;**136-137**:156-64.
17. Horwood J, Cabral C, Hay AD, et al. Primary care clinician antibiotic prescribing decisions in consultations for children with RTIs: a qualitative interview study. *Br J Gen Pract* 2016;**66**:e207-13.
18. Broom J, Broom A, Adams K, et al. What prevents the intravenous to oral antibiotic switch? A qualitative study of hospital doctors' accounts of what influences their clinical practice. *J Antimicrob Chemother* 2016;**71**:2295-9.
19. De Souza V, MacFarlane A, Murphy AW, et al. A qualitative study of factors influencing antimicrobial prescribing by non-consultant hospital doctors. *J Antimicrob Chemother* 2006;**58**:840-3.
20. Grant JA, Dowell J. A qualitative study of why general practitioners admit to community hospitals. *Br J Gen Pract* 2002;**52**:628-30, 32-5.
21. McDermott C, Coppin R, Little P, et al. Hospital admissions from nursing homes: a qualitative study of GP decision making. *Br J Gen Pract* 2012;**62**:e538-45.
22. Newton J, Hayes V, Hutchinson A. Factors influencing general practitioners' referral decisions. *Fam Pract* 1991;**8**:308-13.

23. Gale NK, Heath G, Cameron E, et al. Using the framework method for the analysis of qualitative data in multi-disciplinary health research. *BMC Med Res Methodol* 2013;**13**:117.
24. Bordado Skold M, Aabenhus R, Guassora AD, et al. Antibiotic treatment failure when consulting patients with respiratory tract infections in general practice. A qualitative study to explore Danish general practitioners' perspectives. *Eur J Gen Pract* 2017;**23**:120-27.
25. Li HK, Agweyu A, English M, et al. An unsupported preference for intravenous antibiotics. *PLoS Med* 2015;**12**:e1001825.
26. Sæterdal I AP, Berild D, Harboe I, Odgaard-Jensen J, Reinertsen E, Vist GE, Klemp M. Antibiotic therapy in hospital, oral versus intravenous treatment, The Knowledge Centre for the Health Services. Research overview Available at www.fhi.no/en: The Knowledge Centre for the Health Services., 2010.
27. Cabral C, Horwood J, Hay AD, et al. How communication affects prescription decisions in consultations for acute illness in children: a systematic review and meta-ethnography. *BMC Fam Pract* 2014;**15**:63.

Table 1: Participant characteristics

GP characteristics		
Gender	Male	13
	Female	15
Primary role	Partner	14
	Salaried	8
	Locum	3
	OOH	3
Years as a GP	1-5	7
	6-10	6
	11-15	4
	16-20	3
	≥21	8
Self-reported experience with older adults	Minimal	1
	Moderate	13
	Substantial	14
Practice characteristics		
Location	Rural	7
	Suburban	6
	Urban	6
	Mixed	9
List size	≤ 5000 (small)	5
	5001 – 10000 (medium)	13
	10001 – 15000 (large)	7
	N/A (OOH)	3

Table 2: Key Themes

Main themes	Sub themes
Ways in which prescribing differs for older adults with suspected infection	Broad spectrum antibiotics where location of infection was not clear Earlier administration to reduce the chance of deterioration / admission Duration of antibiotic courses Factors influencing perceived need for Intravenous (IV) antibiotics
Rationale for prescribing antibiotics when the GP was not certain that infection was the cause of the symptoms	Concern over higher risk of deterioration / death Only option if community based care is the ceiling of care
Approaches to using courses of oral antibiotics as a trial of treatment	Duration of trial and expected outcomes Actions taken if initial course of antibiotics does not resolve the symptoms
Risks of antibiotics	Clostridium difficile Antimicrobial resistance

524